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CLEAN HARBORS COLFAX, LLC
COLFAX, LOUISIANA

RCRA PERMIT APPLICATION
PART II

APPENDIX
U

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OFFICE OF ENVIRONMENTAL SERVICES
PERMIT DIVISION

Prepared for:

Clean Harbors Colfax, LLC
3763 Highway 471
Colfax, Louisiana 71417

Agency Interest #32096
LAD 981055791

Volume 3 of 4

AUGUST 2003

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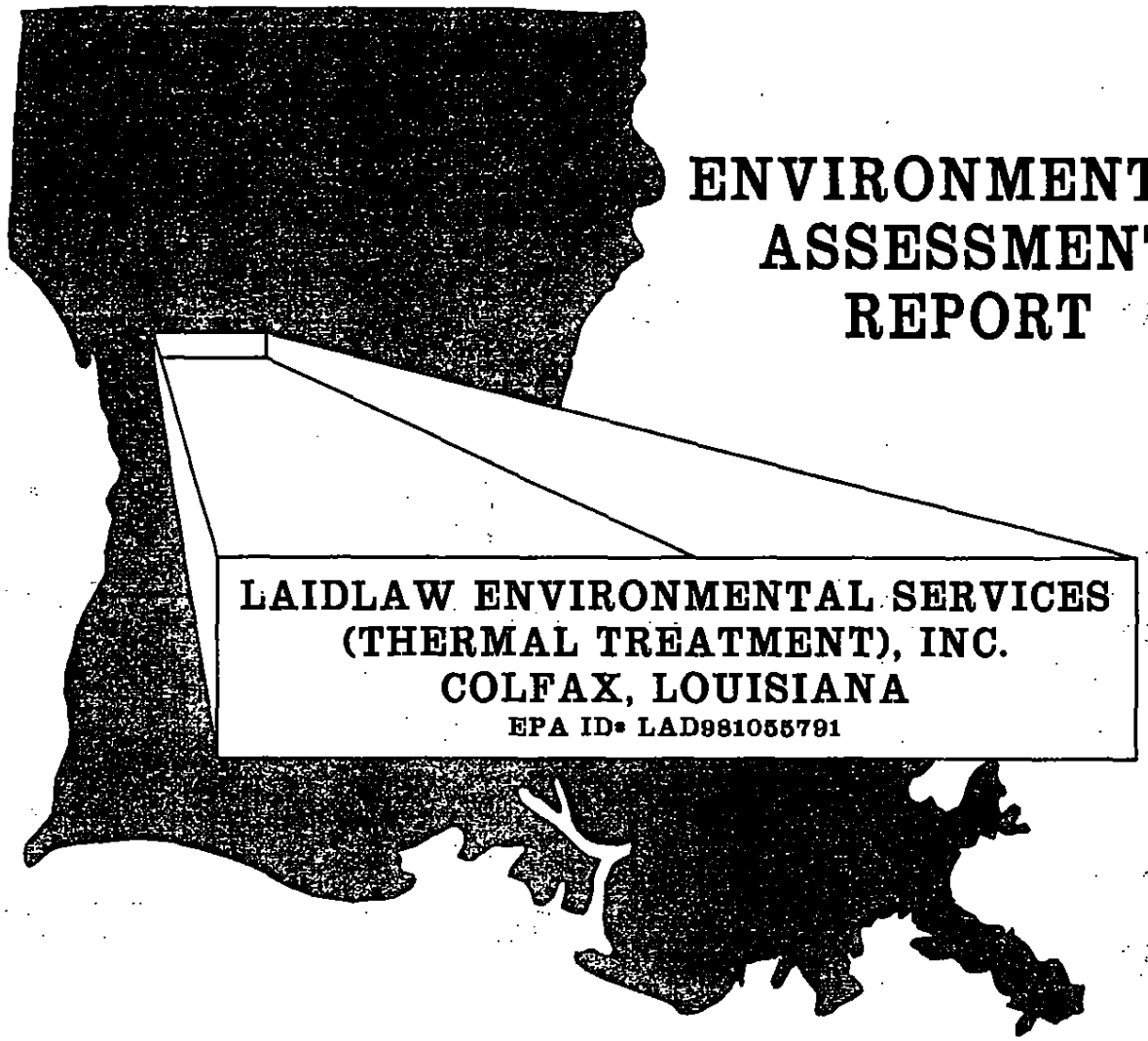
APPENDIX U

ENVIRONMENTAL ASSESSMENT REPORT (1994)



ENVIRONMENTAL ASSESSMENT REPORT

LAIDLAW ENVIRONMENTAL SERVICES (THERMAL TREATMENT), INC. COLFAX, LOUISIANA

EPA ID# LAD981055791

Volume I

January 1994

ViroGroup, Inc. - ETE Division
Greer, South Carolina
Document Number 30912-0194

Environmental Resources Management, Inc.
Ewing, New Jersey

ViroGroup
Air • Water • Soil
TECHNOLOGY

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February 4, 1994

Ms. Thelma Jenkins-Anthony
Louisiana Department of Environmental Quality
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Baton Rouge, Louisiana 70810

Mr. Rafael Casanova
United States Environmental Protection Agency
Hazardous Waste Management Division
RCRA Permits Branch (6H-P)
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: Environmental Assessment Report - Volume I
Laidlaw Environmental Services (Thermal Treatment), Inc.
Colfax, Louisiana
EPA ID# LAD981055791

Ms. Jenkins-Anthony and Mr. Casanova:

On behalf of Laidlaw Environmental Services (Thermal Treatment), Inc., I am submitting to each of you, two copies of the Environmental Assessment Report - Volume I. This volume of the report addresses site characterization and screening assessment for groundwater, wetlands, surface water and soil. A 3.5" diskette of the report is also provided.

Volume II of the report will be submitted under separate cover by ERM, Inc. and will address air quality as well as human health and ecological risk assessments. The two volumes constitute the entire Environmental Assessment Report and address the issues raised in the Work Plan as well as comments received from EPA dated December 7, 1993. There are no other state or local permit requirements or public health requirements in regard to facility operations that have not already been addressed by Laidlaw.

Please contact me if you have any questions regarding Volume I of the EAR.

Sincerely,

Robert J. Hall, P.E.
Regional Manager

Enclosures

ENVIRONMENTAL ASSESSMENT REPORT

LAIDLAW ENVIRONMENTAL SERVICES
(THERMAL TREATMENT), INC.

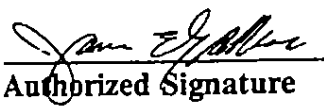
Colfax, Louisiana

EPA ID # LAD981055791

January 1994

STATEMENT OF CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."



Authorized Signature

01/05/94
Date

VICE PRESIDENT OF LAIDLAW ENVIRONMENTAL SERVICES(THERMAL TREATMENT), INC.
Title

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VOLUME II

SECTION V - AIR

SECTION 1

INTRODUCTION

January 1994

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SECTION I - INTRODUCTION

1.1 PURPOSE

On March 31, 1993 the Environmental Protection Agency (EPA) issued a RCRA Subpart X Hazardous Waste Permit to R & D Fabricating and Manufacturing, Inc. for the operation of thermal treatment units and a waste preparation building. The treatment permit was issued after issuance of a storage permit by the Louisiana Department of Environmental Quality (LDEQ) regulating onsite storage of reactive waste. The full RCRA permit was developed under a joint permitting agreement between the EPA and the LDEQ. Subsequently, the facility ownership and permit was transferred to Laidlaw Environmental Services (Thermal Treatment), Inc. Section 264.601 of Subpart X requires that a facility demonstrate compliance with the environmental performance standards to ensure protection of human health and the environment. The environmental assessment process is designed to demonstrate compliance with these standards for affected media of exposure.

An Environmental Assessment Work Plan (EAW) was prepared and submitted to EPA and LDEQ in June 1993. The EAW outlined the site characterization and assessment procedures to be implemented at the LESI facility in order to demonstrate compliance with the environmental performance standards. This Environmental Assessment Report (EAR) documents the field work and modeling procedures used to show that the facility will operate in compliance with the Part 264.601 standards. It incorporates EPA comments on the EAW dated December 7, 1993.

1.2 SCOPE

As stated in the EAW, the assessment scope of work shall address the environmental performance standards of 40 CFR Part 264.601(a), (b) and (c). These standards include the following exposure pathways:

- Groundwater and subsurface environment

- Surface water and wetlands
- Soil surface
- Air

Sections II through V of the EAR address each of these pathways, including site characterization information and the screening assessment.

There are numerous design and operational procedures which will minimize any potential impact to human health and the environment through the listed exposure pathways. These features are discussed in the Subpart X application as well as the EAW. Through conservative modeling and assessment procedures, the EAR addresses release scenarios that, although unlikely to occur, show that the thermal treatment operations will not adversely affect human health or the environment. Ongoing monitoring programs supplement the screening assessment to provide detection of a release after the facility initiates operation.

1.3 UNIT CHARACTERIZATION

The thermal treatment units, storage magazines, preparation building and truck staging areas are fully described in the Part B permit application. The Subpart X application also fully characterizes facility waste management units and qualitatively assesses their impact. Figure 1-1, Site Plan, shows the final location of constructed units at the facility as well as the location of wells and piezometers. Figure 1-2 is a USGS topographic map showing the facility location and significant topographic features surrounding the facility.

1.4 WASTE CHARACTERIZATION

The RCRA permit contains a description of all wastes proposed for treatment. Previously submitted documents which contain information on the waste are as follows:

- "Thermally Treated Waste - Supplemental Information", R & D Fabricating and Manufacturing, Inc., April 1990.

- "Final Source Characterization Plan for the R & D Thermal Treatment System", ENSR, September 1990.
- "Final Technical Support Document for the R & D Thermal Treatment System", ENSR, April 1991.
- "Waste Categories/Waste Stream Hazardous Waste Constituents", LESI, May 1993
- "Response To Item A - Comments To Environmental Assessment Work Plan", LESI, December 1993.

Attachment 1 of the Subpart X application contains analytical results of the ash which show the effectiveness of treatment and which characterizes the material for land disposal. Additional analytical data on ash composition is provided as Appendix 1-A, including analyses for organics, metals and reactivity for cyanide and sulfide.

1.5 SITE CHARACTERIZATION AND SCREENING ASSESSMENT

A significant amount of site characterization data is contained in the permit application and the ENSR report, "Final Technical Support Document for the R & D Thermal Treatment System", April 1991. The EAR includes much of this data and additional information to the extent such information is required to show compliance with the environmental performance standards. The following sections provide a brief overview of site characterization information.

1.5.1 Groundwater and Subsurface Environment

The groundwater and subsurface environment site characterization was completed in two phases. First, a literature search of available government and public data bases was conducted in an attempt to obtain background site information. The second phase consisted of a field investigation that included borings and well/piezometer installation, geophysical logging, and seismic studies. Section II describes the site characterization procedures,

including evaluation of field data.

The screening assessment includes the following tasks:

- Determining the worst-case scenario for a groundwater release, including characterization of the source and environmental setting of this release.

- Determining a worst-case dispersion scenario for the transport of groundwater and modeling to estimate extent of plume and rate and direction of plume migration.

- Providing a qualitative analysis of local groundwater quality.

In order to screen the potential impact of a breach in the concrete pad under a worst-case scenario, LESI assumed that target contaminants migrated through the breach and reached the underlying soil and groundwater. The Organic Leachate Model (OLM) and Vertical Horizontal Spread Model (VHSM) were used to assess movement of contaminants via the subsurface soil and groundwater. The OLM simulates leaching of contaminants in the same manner as the TCLP procedure and is described fully in Section II. Target contaminants included metals contained in Section 3.4.3.1 of the EAW, mercury and select organic constituents previously included in soil sampling conducted around the existing burners. Resulting target contaminant concentrations in the groundwater were compared to existing state or federal groundwater quality criteria and health based criteria to evaluate potential impact.

1.5.2 Wetlands and Surface Water

A wetlands consultant was retained to delineate any wetland areas within the facility boundary. Section III contains the consultant's report and conclusions that indicate there are no wetlands located at the facility. Additional information is provided on the wetlands

area nearest the facility as taken from the National Wetlands Inventory map. Documentation from the Army Corps of Engineers which indicates their concurrence with the wetlands study is provided.

Topographic and flood plain maps were used to assess surface water bodies near the facility. U.S. Geological Survey Water-Data Report LA-92-1 and Louisiana Water Quality Regulations were reviewed to determine if water quality criteria had been assigned to area waters receiving discharge from the facility. Climatological data was obtained from the National Climatic Data Center and Louisiana State University.

In order to screen the potential impact of this runoff on surface water or wetlands under a worst case scenario, LESI assumed that target contaminants (i.e., Section 3.4.3.1 - EAW, mercury) were removed from the pad through a specified storm event. The concentration of each contaminant was determined through particulate deposition modeling (Section V). A determination of the target constituent concentration in the retention pond discharge was made and compared to appropriate water quality criteria.

1.5.3 Soil Surface

Site characterization of the soil surface was completed in conjunction with the characterization of groundwater and subsurface environment (Section II). Information on the soil surface includes published data on soil types and local seismic activity. Data on soil thicknesses, composition, permeabilities, porosities, and depth to bedrock was compiled through review of published data and field investigation. Additional soil information is contained in Appendix 3-A, Wetlands Determination Report.

A previously submitted Soil Sampling Plan for the proposed thermal treatment units is included in Section IV. Subsequent to EPA approval, this plan will be implemented by the facility to characterize the soil surface downwind of the treatment units on an ongoing basis.

There will be no direct release of waste material to the soil due to the containment features of the waste management units and operational features regarding collection of residues and spilled materials. Two potential scenarios involving contaminant migration through the soil pathway include:

- Deposition of particulates with removal through surface runoff
- Percolation of contaminants to groundwater resulting from particulate deposition on the soil surface.

Surface runoff of particulates is considered in the surface water assessment (Section III) with runoff from the concrete slab as the worst case scenario. Percolation of particulates to groundwater will be considered in the groundwater assessment (Section II). Fugitive dust emissions from vehicular traffic is considered to be a minor potential source of particulates and is assessed for its dust contribution to ambient air quality as described in Section 4.2.1.

1.5.4 Air

The air quality site characterization and screening assessment was performed by Environmental Resources Management, Inc. (ERM) of Ewing, New Jersey. ERM used information available from the National Climatic Data Center (NCDC) and the Alexandria, LA airport hourly observations to define atmospheric conditions such as prevailing wind speed, wind direction and atmospheric stability. US Geological Survey (USGS) topographic maps helped to define terrain features which may affect the dispersion environment in the vicinity of the facility.

Air pollution measurement data was obtained from the Louisiana Department of Environmental Quality (LDEQ) and the US Environmental Protection Agency (USEPA) and/or the air pollution technical literature. Specific attention was focused on the availability and analysis of heavy metals data from ambient air monitoring programs in

central Louisiana. This analysis provided information for comparison of modeled off-site heavy metal concentrations with prevailing metal levels in central Louisiana.

The air media screening assessment contained in Section V includes the following components:

- Emission estimation;
- Air dispersion and depositional modeling;
- Human health risk assessment; and,
- Ecological risk assessment.

ERM reviewed available explosive manufacturer's data and technical literature in an attempt to obtain information on waste constituents. Based upon this research and previous emissions testing conducted at the facility, ERM developed "reasonable worst-case" emission estimates for the facility for target contaminants contained in Section 3.4.3.1 of the EAW and mercury.

The Industrial Source Complex Version 2 (ISC-2) Model was used to estimate off-site ambient air impacts and to predict dry deposition patterns. A human health risk assessment was performed with particular attention given to ingestion of contaminated soil and inhalation of particulates. An ecological risk assessment was performed also and consists of four parts: problem formulation, exposure assessment, ecological effects assessment, and risk characterization.

SECTION II
GROUNDWATER AND SUBSURFACE ENVIRONMENT

January 1994

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2.1 SITE CHARACTERIZATION

2.1.1 INTRODUCTION

2.1.1.1 Purpose of Investigation

ViroGroup, Inc. (VG) was contracted on March 18, 1993 by Laidlaw Environmental Services (Thermal Treatment), Inc. to perform a hydrogeological site characterization in support of the environmental assessment for the thermal treatment facility located in Colfax, Louisiana.

This investigation was divided into two (2) phases. In the first phase, VG conducted a literature search of available government and public geological and hydrogeological data bases in an attempt to obtain background information on the site's subsurface geology/hydrogeology. Phase II was a field investigation that involved exploration of the site's subsurface geological and hydrogeological characteristics. This investigation utilized soil borings, installation and development of monitor wells, geophysical well logging, and shallow seismic studies in order to obtain the necessary data.

2.1.1.2 Literature Search

Local divisions of the United States Geological Survey (USGS) were contacted to determine if any information was currently available describing the geology of the Colfax area. USGS information revealed that the subject area is located within a geologic formation called the Catahoula Formation and that detailed site specific information should be available from the following sources: Louisiana Department of Transportation and Development, United States

Army Corps of Engineers, Louisiana Geological Survey, and/or the Louisiana State University's library system.

Bradford C. Hanson, Senior Research Geologist with the Louisiana Geological Survey (LGS), indicated that the site is located within the Catahoula Formation and consists of sandstones, siltstones, volcanic tuffs (welded and unwelded), silts, and clays. He also stated that the Colfax area has not been fully investigated by the LGS.

The Louisiana Department of Transportation and Development (LDOTD) conducted a computer search of their water well records to determine if any water wells were completed in the site's vicinity and if the drilling logs were available. Subsequent review of the records provided by LDOTD indicated that the recorded well location nearest the site was approximately two miles to the southwest, and that the available well log information would be inadequate to characterize the site.

ViroGroup contacted the United States Army Corps of Engineers (USACE) on March 23, 1993 to obtain copies of the boring log information they acquired during construction of the IATT Red River project located adjacent to the subject site. The IATT Reservoir is located approximately five miles southeast of the site. The USACE borings were relatively shallow in depth (less than 25 feet). Review of the site's location indicated it was in a different geological formation and thus yielded little, if any, useful information about the site.

There are four water wells in use within a two (2) mile radius of the property boundary. These wells are:

1) West Grant Water District Well located in Section 13. This well is 65 feet deep and seldom used due to high iron content in the water.

2) West Grant Water District Well located in Section 24. This well is 65 feet deep and seldom used due to high iron content in the water.

3) A private well, owned by Mr. John Antee, located in Section 23. This well is 37 feet deep and is used for human consumption.

4) A private well, owned by Ms. Dauzat, located in Section 29. This well is 35 feet deep and is used for human consumption.

The document *Water Resources of the Terrace Aquifers, Central Louisiana*, prepared by the USGS and the LDOTD, 1981, was reviewed to determine general water quality characteristics in the area. Central Louisiana is mapped into four terrace deposit formations: the Williana, Bentley, Montgomery, and Prairie Formations. These formations consist generally of an upper clay and silt layer and a lower sand and gravel layer. The terrace aquifers occur in the sands and gravels of these formations. The aquifer occurring in the Prairie Formation is referred to as the Prairie aquifer. The thickness of the Prairie aquifer ranges from 10 to 130 feet. According to this document, the West Grant Water Association owns a water well located along Highway 471, approximately 0.5 mile from the property boundary. This well (G-392), located in section 13, is 45 feet deep and is screened in the Prairie aquifer. The water level

in well G-392 was 7 feet below ground surface on October 4, 1973; and the well produced 150 gallons per minute on May 19, 1976. Water samples collected from this well on October 9 and 12, 1973 revealed the following: specific conductance - 98 μmhos, pH - 6.0 and 5.9, hardness - 12 and 5 mg/l, dissolved calcium - 2.4 and 1.2 mg/l, dissolved magnesium - 1.5 and 0.4 mg/l, dissolved sodium - 21 and 25 mg/l, dissolved sulfate - 1.0 and 1.6 mg/l, dissolved chloride - 15 and 20 mg/l, dissolved fluoride - 0.2 and 0.1 mg/l, dissolved solids - 108 and 81 mg/l, dissolved iron - 300 and 100 μ/l, and dissolved manganese - 0 and 20 μ/l.

2.1.2 FIELD INVESTIGATION

This section describes the field activities conducted between May 3, 1993 and July 23, 1993; and between December 21 and December 23, 1993.

2.1.2.1 Soil Borings

Geotechnical Testing Laboratory, Inc. (GTL) was contracted to complete six (6) shallow (less than 20 foot deep) geotechnical borings at the site (Appendix A). These borings were completed to determine the geotechnical parameters of the site's surficial soils. Borings were drilled utilizing a truck-mounted hydraulic drill rig with eight inch outside diameter (O.D.) and 4.25 inch inside diameter (I.D.), hollow stem augers, according to standard auger drilling techniques. Soil samples were obtained at 5 foot intervals by advancing a standard 24 inch split spoon sampler ahead of the hollow stem augers using a 140 lb. hammer free-falling 30 inches (ASTM D1586-67) or by hydraulically advancing the split spoon. All drilling and sampling equipment (drilling, augers, samplers, hand tools, etc.) was decontaminated by steam cleaning prior to and between borings and sampling points.

In order to gain additional information regarding site stratigraphy, Groundwater Protection, Inc. (GP) was contracted to install six (6) deep borings at depths of 40 to 160 feet BGS (Appendix B). These borings were installed with a hollow stem auger until groundwater was encountered and then advanced to completion using mud rotary methods. The borings were

sampled continuously and samples were visually logged using a modified Unified Classification System.

The sample cores were preserved by a VG hydrogeologist on site and were subsequently sampled and field screened by head space analyses using a Photo-Ionization Detector (PID) with a 10.6 electron volt probe (calibrated to Isobutylene) utilizing field headspace protocol for volatile organic vapors. The samples exhibiting the highest PID readings were submitted under chain-of-custody for laboratory analyses of parameters stipulated in the Environmental Assessment Work Plan. A summary of soil sample analytical results are contained in Table 2-2. In addition, specific stratigraphic horizons (confining clays and aquifer sands) were sampled and submitted for geotechnical analyses to Geotechnical Testing Laboratories, Inc. (Appendix C). Two samples were submitted to Gore Labs, Inc. for grain size analysis (Appendix D).

2.1.2.2 Monitor Wells and Piezometers

Two (2) of the soil borings were converted to groundwater monitoring wells, MW1 and MW2. MW1 and MW2 were completed to 145 and 40 feet BGS, respectively. The monitoring wells were constructed using flush-joint, 4-inch diameter schedule 40 blank PVC riser pipe and machine slotted schedule 40 PVC well screen with 0.010-inch slots. Three (3) of the soil borings were converted to piezometers, P1, P2, and P3. P1, P2, and P3 were completed to 150, 160, and 40 feet BGS, respectively. Additionally, piezometers P4 and P5 were completed on

December 21 through 23, 1993 to a depth of 46 feet BGS and 50 feet BGS, respectively. The piezometers were constructed using flush-joint, 2-inch diameter schedule 40 blank PVC riser pipe and machine slotted schedule 40 PVC well screen with 0.010-inch slots. The well screens were placed in each of the borings to intersect the water table and to allow for potential fluctuations in the groundwater table.

The annulus between the well screen and borehole wall was filled with a uniformly graded 20/40 sand filter pack, extending one foot above the top of the screen. In addition, one (1) foot of fine sand was placed above the filter pack as required by LDEQ/LDOTD regulations. A one foot bentonite pellet seal was placed above the fine sand filter pack and hydrated 12 hours to seal the annulus and prevent surface water from entering the well through the annular space. The remaining annular space was grouted to the surface with a cement-bentonite grout. Threaded caps were placed on the bottom of each well and locking caps were attached to the top. Protective steel casings, with locking caps, were placed over the well riser pipe. The protective casings were set approximately two (2) feet below ground level and cemented in place. The ground surface around the wells were covered by a 3' X 4" thick concrete slab to protect the well casing. Furthermore, the well casings were protected by installing four 4-foot long, 3-inch diameter concrete filled steel posts on each corner of each concrete pad.

The monitoring wells and piezometers were developed following installation, in order to provide development to the sand pack. Each well was developed by removing at least six

calculated well volumes using a submersible pump. Well development was continued until a chemically stable groundwater was obtained. The development procedures were performed to remove any sediments introduced during well construction and to assure response of the wells to local groundwater conditions.

All downhole drilling, sampling, and associated equipment were cleaned and decontaminated by the following procedures:

1. Cleaned with tap water and laboratory grade, phosphate-free detergent, using a brush, if necessary, to remove particulate matter and surface films. Steam cleaning was utilized to remove material that was difficult to remove with the brush. Hollow-stem augers were cleaned on the inside and outside. The steam cleaner was capable of generating a pressure of at least 2500 PSI and producing steam at 200°F plus.
2. Rinsed thoroughly with tap water.
3. Rinsed thoroughly with deionized water.
4. Air dried.

A cleaning and decontamination area was designated on site, downgradient and downwind from the clean equipment drying and storage area.

2.1.2.3 Groundwater Sampling

All monitoring wells and piezometers were allowed to stabilize before purging and sampling. Water levels in each well/piezometer were measured with the use of an electric water level meter. The volume of water in each well/piezometer was then calculated using the following formula:

$$V = (T.D. - W.L.) \times 0.163$$

V = volume of water in the well (gals.)

T.D. = total depth of the well (ft)

W.L. = depth to the water table (ft)

0.163 = gallons of water in one foot section of two inch diameter section (gals./ft.)

At least three (3) volumes of water were purged from each well/piezometer. The wells/piezometers were purged and sampled utilizing a submersible pump and plastic tubing (hose). All pump equipment was decontaminated before purging of each well/piezometer by the following steps:

1. Pumped a sufficient amount of Alconox solution through the hose to flush out any residual purge water.
2. Scrubbed, using a brush, the exterior of the contaminated hose and pump with hot Alconox solution. Rinsed the soap from the

outside of the hose with potable water. Rinsed the hose with deionized water and recoiled onto the spool.

3. Pumped a sufficient amount of potable water through the hose to flush out Alconox solution.
4. Pumped a sufficient amount of deionized water through the hose to flush out the potable water.
5. Rinsed the outside of the pump housing and hose with deionized water (approximately 1/4 gallon).
6. Placed equipment in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

Indicator field parameters measured during well/piezometer sampling included specific conductance, temperature, and pH. These indicator parameters were measured before and during purging until three (3) consecutive stable measurements were recorded (temperature, specific conductance, and pH to within ± 10%). If the indicator parameters had not stabilized after three (3) volumes had been removed, the well/piezometer was sampled. If the well/piezometer was pumped dry before the above requirements were met, then the sample was collected upon recovery. Temperature, specific conductance, and pH was measured, in the field, for each groundwater sample utilizing a Hydac Digital Conductance, Temperature, and pH Tester. All measuring devices were decontaminated prior to use at another well by

rinsing with deionized water. Also, the measuring devices were flushed with the sample at the next location before taking measurements.

All groundwater samples were placed in specially prepared pre-designated decontaminated glass containers provided by the laboratory. Each sample was preserved by cooling to approximately 4 degrees centigrade for transportation to the laboratory. EPA SW-846 guidance sampling protocol, including chain-of-custody procedures, were followed to insure sample integrity. All sample containers were labeled accordingly with the following information: project number, sample station number, date and time of sample collection, designation of the sample as a grab or composite, type of sample with a brief description of sampling location, signature(s) of the sampler(s), whether the sample is preserved or unpreserved, the general types of analyses to be conducted, any relevant comments (such as readily detectable or identifiable odor, color, etc.). Groundwater samples were analyzed for the parameters stipulated in the Environmental Assessment Work Plan. A summary of groundwater analytical results is contained in Table 2-1.

All non-dedicated sampling equipment was decontaminated before each use utilizing the following steps:

1. Cleaned with tap water and laboratory detergent using a brush if necessary to remove particulate matter and surface films.
2. Rinsed thoroughly with tap water.

3. Rinsed thoroughly with deionized water.
4. Rinsed thoroughly with organic-free water and allowed to air dry as long as possible.
5. Wrapped with aluminum foil, before storage or transportation.

All liquid investigation derived waste (IDW) (i.e., purged water from monitoring wells, cleaning fluids, and washwater) was drummed and stored on site. All drill cuttings/soil boring cuttings were drummed and stored on site. Because piezometers P1 and P2 would interfere with site construction activities, they were plugged and abandoned according to LDEQ/LDOTD guidelines after the groundwater sampling and geophysical logging were completed.

2.1.2.4 Geophysical Logging and Seismic Studies

On July 20-23, 1993, SDII, Inc. performed geophysical well logging and seismic studies at the site. SDII logged five (5) of the completed wells/piezometers using induction and gamma ray methods (Appendix E). SDII also constructed five shallow seismic lines (less than 400 feet) across the site. Appendix F contains the SDII final report which outlines the methodology and results of the seismic study.

2.1.3 ANALYTICAL TESTING

2.1.3.1 Chemical

Soil and groundwater samples taken from soil borings, monitor wells, and piezometers were preserved on ice and submitted to SPL Laboratories for analyses of volatile organic compounds, semi-volatile organic compounds, RCRA metals, HPLC (explosive related compounds), and organic carbon. The laboratory analytical results are summarized in Tables 2-1 and 2-2. Laboratory quality control documentation is included in Appendix G.

2.1.3.2 Geotechnical

Soil samples for geotechnical analyses of Atterberg limits, percent moisture, and permeability were submitted to Geotechnical Testing Laboratory, Inc. (Appendix C). Soil samples for sieve analyses were submitted to Gore Engineering, Inc. (Appendix D).

2.1.4 OBSERVATIONS AND ANALYTICAL RESULTS

2.1.4.1 Soil Borings, Monitor Wells, and Piezometers

All soil borings indicate that an extremely variable subsurface stratigraphy exists beneath the site (Appendix A).

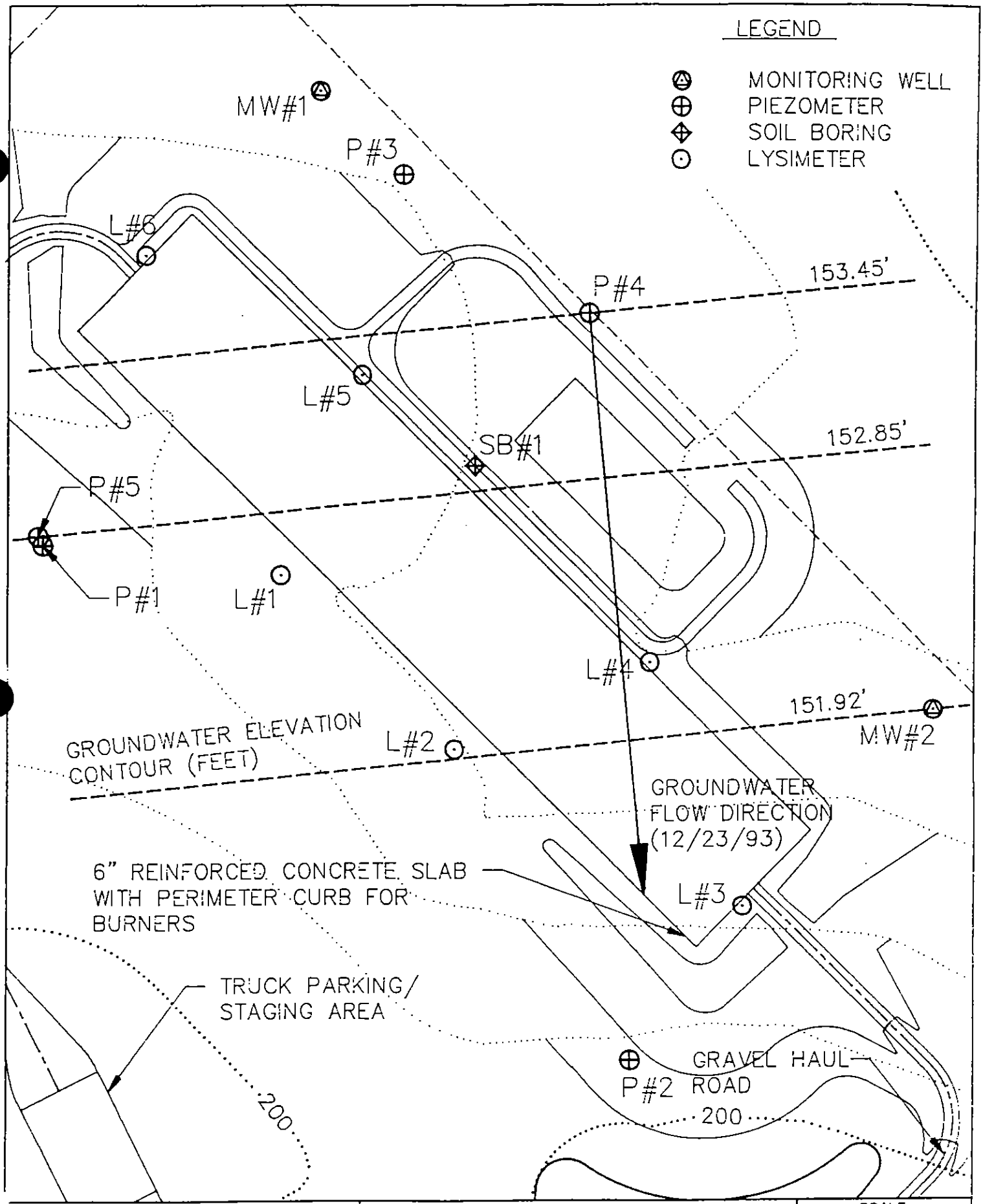
Monitor wells and piezometers encountered a minimum of two (2) distinct water bearing zones beneath the site. Moreover, it appears that the confining (clay) layers are highly fractured. MW2, P3, P4 and P5 were installed in the upper (surficial) aquifer; while MW1, P1, and P2

were installed in the lower aquifer. Depth to groundwater was measured in MW1, P1, and P2 in July, 1993. Depth to groundwater was measured in MW2, P3, P4, and P5 in December 1993. The location and elevation of the ground surface for each well/piezometer were surveyed in order to convert the measured depth to water to an elevation of groundwater. Potentiometric surface maps were constructed from the groundwater elevation data in order to evaluate the groundwater flow direction and the hydraulic gradient of both the upper (Figure 2-1) and lower (Figure 2-2) aquifers. According to the collected potentiometric data, groundwater in the upper aquifer was determined to be flowing in a south-southeast direction, with a hydraulic gradient of 0.6 feet/130 feet (0.0046 ft/ft). Groundwater in the lower aquifer was determined to be flowing in a southeast direction, with a hydraulic gradient of 4.06 feet/622 feet (0.0065 ft/ft).

The geophysical logs of the monitor wells and piezometers are similar to the interpretation of the physical logs and provide valuable information in correlating the site's complex subsurface stratigraphy between boring locations.

2.1.4.2 Seismic Lines

SDII's five (5) seismic lines (100-500) provide additional evidence of the existence of a complex subsurface stratigraphy beneath the site. The seismic report (Appendix F) notes that two (2), and possibly three (3), of the seismic lines show a potential fault bisecting the site in an east-to-west direction.



DRW. #3

ViroGroup Air•Water•Soil TECHNOLOGY

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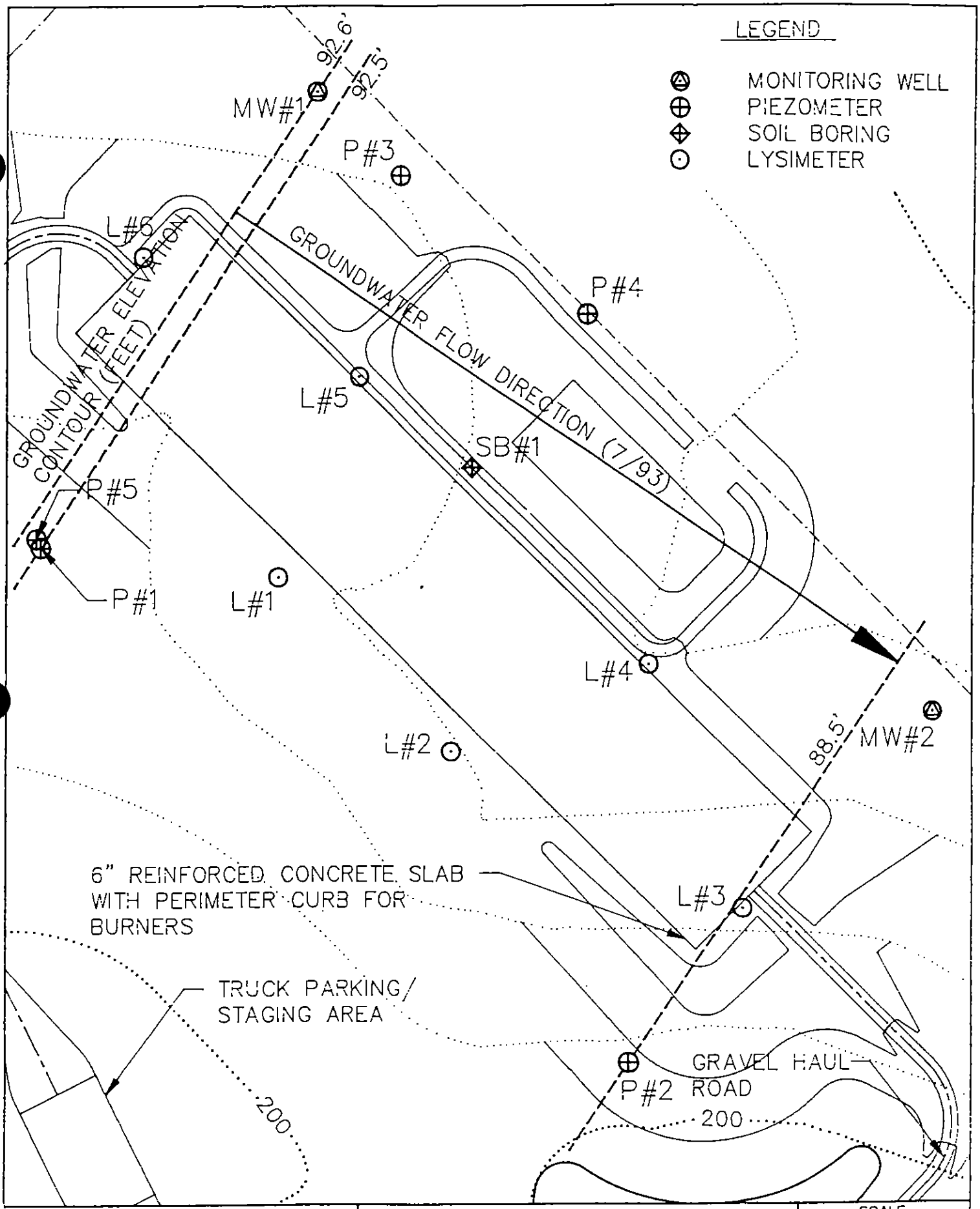
LAIDLAW ENVIRONMENTAL SERVICES
THERMAL TREATMENT, INC.

UPPER AQUIFER POTENTIOMETRIC SURFACE

SCALE	1"= 100'
DATE	1/94
PROJECT NO.	16-30912



DRW. #3 7

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LAIDLAW ENVIRONMENTAL SERVICES
THERMAL TREATMENT, INC.

LOWER AQUIFER POTENTIOMETRIC SURFACE

SCALE	1"= 100'
DATE	1/94
PROJECT NO.	16-30912

2.1.4.3 Laboratory Analyses

Chemical analyses of groundwater samples taken from the site show that low levels (6.0 ug/ml) of Diethylphthalate (possibly relating to sample tubing composition) were found in water samples P1-W1 and P2-W2. Low levels (22 - 140 ug/L) of Phenol of unknown origin were found in all groundwater samples. Phenol is a common industrial chemical used in resins, plastics, and adhesives. Phenol is also found as a natural component of animal tissue. Phenol, if released into the environment, biodegrades at a rapid rate (days). Since the LES operations area is virgin (unimproved) land, it is possible the phenol concentrations detected in the groundwater samples may be naturally occurring. It is also possible the phenol concentrations detected in the groundwater samples may have been emitted from drilling and/or sampling equipment. Groundwater analytical results are tabulated in Table 2-1.

Analytical results for the soil samples exhibited levels well below regulatory limits for all parameters tested. Soil sample results are tabulated in Table 2-2.

Geotechnical analyses of clay samples taken from the site indicate that subsurface clay layers have very low permeabilities in the range of 10^{-5} to 10^{-7} cm/sec. Sieve analyses of water bearing sands (aquifers) encountered at the site indicate the sands are of medium grain size and well sorted.

2.1.5 CONCLUSIONS AND INTERPRETATIONS

The following section contains VG's observations (O) and subsequent interpretations (I) of data compiled during field activities completed at the site. Interpretations were derived from the evaluation of boring logs and seismic data obtained during field operations and subsequent construction of six (6) cross sections (Appendix H) and one fence diagram (Appendix I).

The six (6) cross sections and one (1) fence diagram are discussed fully in the following format:

O. First, an observation of the data revealed by the referenced cross section or fence diagram will be stated.

I. Next, a specific stratigraphic and sedimentological interpretation will be made from the observation.

2.1.5.1 Cross Sections

Cross Section P1 to MW1

O. In cross section P1-MW1 the upper sandstone decreases in thickness from west to east.

I. This is most likely due to original topography and sedimentary processes during the unit's original deposition.

O. The upper aquifer is not present in MW1 and the lower aquifer is much thicker in MW1 and thinner in P1.

I. The upper aquifer sand unit is discontinuous; it pinches out before reaching MW1 and is likely to be a channel sand typical of meandering stream deposits. This is shown by the cross section's correlations (Appendix H) and results of the seismic survey through this section (Appendix F).

O. The lower confining clay is present below the lower aquifer in MW1 and P1.

I. The lower confining clay may be continuous across the site.

Cross Section MW1 to MW2

O. In this cross section the sandstone unit is continuous across the site, although it varies in thickness.

I. The thickness variation in this unit is most likely due to original topography and sedimentary processes during the unit's original deposition.

O. The upper aquifer varies in thickness from SB1 to MW2 and is absent in P3 and MW1.

I. This upper aquifer is not continuous; it pinches out between SB1 and P3 and is probably a channel sand typical of a meandering stream environment. This can be seen in the cross section (Appendix H) and the seismic line 300 (Appendix F).

O. The lower confining clay layer is not encountered in P3, SB1, and MW2.

I. The lower confining clay layer is not encountered because of the shallower depth of completion of P3, SB1, and MW2.

Cross Section P1 to P2

O. In this cross section the sandstone unit is continuous across the site, although it varies in thickness.

I. The thickness variation in this unit is most likely due to original topography and sedimentary processes during the unit's original deposition.

O. The upper aquifer pinches out between P1 and P2 and is absent in P2.

I. This upper aquifer is not continuous; it pinches out between P1 and P2 and is probably a channel sand typical of a meandering stream environment. This can be seen in the cross section (Appendix H) and the seismic line 400 (Appendix F).

O. The lower aquifer decreases in thickness from P1 to P2.

I. The decrease in thickness of the lower aquifer from P1 to P2 is probably due to sedimentary processes during the unit's deposition.

O. The lower confining clay layer is present below the lower aquifer in P1 and P2.

I. The lower confining clay layer may be continuous across the site.

Cross Section P2 to MW2

O. The upper sandstone unit thins from P2 to MW2.

I. The thickness variation in this unit is most likely due to original topography and sedimentary processes during the unit's original deposition.

O. The upper aquifer pinches out between P2 and MW2.

I. This upper aquifer is not continuous; it pinches out between P2 and MW2 and is probably a channel sand typical of a meandering stream environment. This can be seen in the cross section (Appendix H) and the seismic line 100 (Appendix F).

O. The existence of the lower aquifer and lower confining clay is not confirmed at MW2.

I. MW2 did not confirm the existence of the lower aquifer or lower confining clay due to its shallow depth of completion.

Cross Section P1 to SB1

O. The upper sandstone layer keeps the same relative thickness between these two locations.

I. The thickness of the unit is probably due to sedimentary processes during the unit's original deposition.

O. The upper aquifer is slightly thicker at SB1 than at P1.

I. Since the upper aquifer is not continuous across the site and is probably a channel sand, it is reasonable to assume that sand thickness is related to the location where the boring intersected the channel (i.e., thicker sand would occur in the center of the channel). If this is the case, the sand body encountered by this boring could be the center of one of the discontinuous channel sands that underlie the site.

O. The existence of the lower confining clay is not confirmed in SB1.

I. SB1 did not confirm the existence of the lower confining clay due to its shallow depth of completion.

Cross Section P1 to MW2

O. The upper sandstone is slightly thicker at MW2 than at P1.

I. The thickness variation between P1 and MW2 is probably due to sedimentary processes during the unit's original deposition.

O. The upper aquifer is slightly thicker at MW2 than at P1.

I. The upper aquifer is not continuous across the site, and thicker sands may indicate proximity to the center of the paleochannel (pre-depositional stream channel).

O. The existence of the lower aquifer is not confirmed in MW2.

I. MW2 did not confirm the existence of the lower aquifer due to its shallow depth of completion.

O. The existence of the lower confining clay is not confirmed in MW2.

I. MW2 did not confirm the existence of the lower confining clay due to its shallow depth of completion.

2.1.5.2 Fence Diagram (Appendix I)

O. The upper sandstone unit appears in all soil borings.

I. The sandstone unit appears continuous across the site. Because of the lack of obvious fluvial related features, the unit was probably deposited through wind deposition.

O. The upper sandstone varies in thickness across the site.

I. Because this unit probably resulted from the wind deposition of volcanic tuffs (easily erodible), the variation in thickness is probably due to post-depositional erosion prior to burial and lithification.

O. The sandstone unit is made up of one or possibly two discrete layers.

I. These unit(s) were probably deposited during the course of a number of ash fall events and were later reworked and redeposited, creating the variations in bed number and thickness.

O. The upper aquifer is not continuous across the site.

I. The upper aquifer appears to be a channel sand that extends northwest to southeast beneath the site.

O. The lower aquifer and the lower clay layer may be continuous beneath the site.

I. The hypothesis that the lower aquifer and lower clay layer may be continuous across the site is tentatively supported by the seismic study data.

2.2 SCREENING ASSESSMENT

The models chosen to estimate the potential impact to ground water quality at an assumed downgradient receptor point were the Organic Leaching Model (OLM) and the Vertical and Horizontal Leaching Model (VHS). These models were produced for the United States Environmental Protection Agency (EPA) to simulate the leaching characteristics of organic and inorganic constituents that potentially could be found in landfills or hazardous material. The OLM can be used to estimate the organic leachate concentrations at the point the leachate reaches ground water. The model assumes no attenuation or degradation of the organic constituents being modeled as they travel through the unsaturated zone. The results from the OLM are used as input to the VHS model. For the inorganic portion of a leachate (i.e. input for the VHS model) it is assumed that metals will remain dissolved throughout the infiltration process and the concentration of metals in the leachate will be approximately the same as in the original waste stream.

Dilution and dispersion of the leachate once it reaches the water table can be modeled to a downgradient compliance point using the VHS model. The analytical solute transport model and be used to predict maximum concentration of a pollutant at a prescribed distance downstream of a constant source. For organic leachate constituents the results of the OLM are used as input for the VHS model. For the inorganic parameters the original concentrations of metals are used. The VHS model is very conservative in that it assumes no volatilization and no attenuation on the geologic material of any of the constituents. Originally designed to be used to determine RCRA delisting status, the OLM and VHS models are referenced in the Federal Register at 40 CFR Part 260, Vol. 51, p.41082/November 13, 1986 and 40 CFR Part 261, Vol. 50, No.2 29/November 27, 1985, respectively. Included in Appendix J is a copy of the original VHS model published by Domenico and Palciauskas in Ground Water, Volume 20, No.3, pp.301-311, 1982, and the results from a model verification performed by the International Ground Water Modeling Center at the Colorado School of Mines, Institute for Ground-Water Research and Education, Golden, Colorado.

The storage, preparation, and treatment areas of the facility have secondary containment to preclude dispersal via runoff of precipitation. The thermal treatment area is the worse-case management area in terms of the potential for wastes or contaminants to escape the management units. Each treatment unit contains a concrete containment area surrounded by a larger concrete pad. A 'worse case' scenario was estimated for two possible events; an instantaneous and complete breach of a burner pad allowing for the direct release of target

contaminants to the unsaturated zone and then potential percolation to the saturated zone; and the complete leaching of the most concentrated atmospheric deposition of targeted compounds (estimated from air quality modeling) from the surface soil surrounding the concrete pads. A point (the fence line surrounding the facility) 695 feet downgradient, based on the shallow aquifer potentiometric surface configuration, of the edge of the burner pad was chosen as the most conservative potential receptor point.

2.2.1 SCENARIO I - PAD BREACH

To simulate a breach in the concrete pad beneath a burner unit it was assumed that targeted compounds were released through a diagonal break 22.63 feet long, .25 feet wide and one foot deep. A breach of these dimensions would contain 5.65 cubic feet of waste material. For input into the EPA modified VHS the following parameters were used:

Contaminant concentration	For organic constituents the output from the OLM (Table 2-3) was used. For the inorganic constituents, the concentration as determined from previously completed analytical work was used.
Width of a single disposal trench	0.25 feet, i.e. the width of the breach.
Transverse dispersivity	6.56168 feet - prescribed by the USEPA.
Distance to receptor	695 feet - from the nearest edge of the pad to the fence line (receptor point) in a downgradient direction.
Waste volume	5.65 cubic feet - 22.63 feet x .25 feet x 1.0 feet.

Cross-sectional area of disposal site normal to ground water flow direction	22.63 feet.

The results of the modeling for the various constituents are shown in Table 2-4.

2.2.2 SCENARIO II - SURFACE DEPOSITION

The same model inputs were used for simulating the leaching of contaminants from surficial soils with the exception of the contaminant concentration values, waste volumes, and simulated trench lengths. Predicted values from air quality modeling (Section V) for deposition of selected compounds on soils surrounding the burner pads were used for calculating model inputs. As before, a worse case scenario was assumed by using maximum predicted values and completely soluble target compounds.

To calculate assumed concentrations in leachate it was assumed that 50 inches of precipitation are available annually to dissolve the compounds modeled in the soils. It is further assumed that the compounds in the soil are completely dissolved in the precipitation and there is no attenuation. If the calculated concentrations were greater than the published solubility data for the metal in question, then the solubility value was used as model input. If the calculated value was less than the published solubility value, then the calculated value was used because it represented all of the metal that was available for leaching. For input into the EPA modified VHS the following parameters were used:

Contaminant concentration	A calculated value for each compound based on assumed precipitation and air modeling deposition values.
Width of a single disposal trench	4.64 feet, i.e. the diagonal length of a square meter.
Transverse dispersivity	6.56168 feet - prescribed by the USEPA.

Distance to receptor	695 feet - from the nearest edge of the pad to the fence (receptor point) in a downgradient direction.
Waste volume	A calculated value for each compound based on annual deposition and compound density.
Cross-sectional area of disposal site normal to ground water flow direction	4.64 feet.

The results of the modeling for the various constituents are shown in Table 2-5.

2.2.3 INTERPRETATION OF RESULTS

The predicted concentrations of target compounds in ground water at the receptor point for both scenarios were compared to either drinking water standards (MCLs, SMCLs, or Action Levels - benzene, ethylbenzene, toluene, xylene, aluminum, antimony, barium, beryllium, chromium, copper, lead, mercury, nickel, selenium, and zinc) or if no drinking water standard was available, a health based exposure value such as a No Observed Adverse Effect Level (NOAEL - nitrobenzene, dinitrobenzene, trinitrobenzene, trinitrotoluene, methyl ethyl ketone, acetone), oral reference dose, or Health Advisory (HA - RDX, HMX, dinitrotoluene). The values were obtained through TOXNET, the EPA computerized data base. No water solubility data was available for the compound HMX, but the amount of HMX in the waste (3.45 mg/kg) is less than the Health Advisory (5.0 mg/l). No data was available on the potential health effects of Tetryl, but based on the OLM and VHS modeling the predicted concentration at the compliance point is zero. In no instance did the model predict an violation of a standard. Based on the results from EPA sanctioned models, there will be no adverse impact on ground water quality at the downgradient receptor point from operations at the facility.

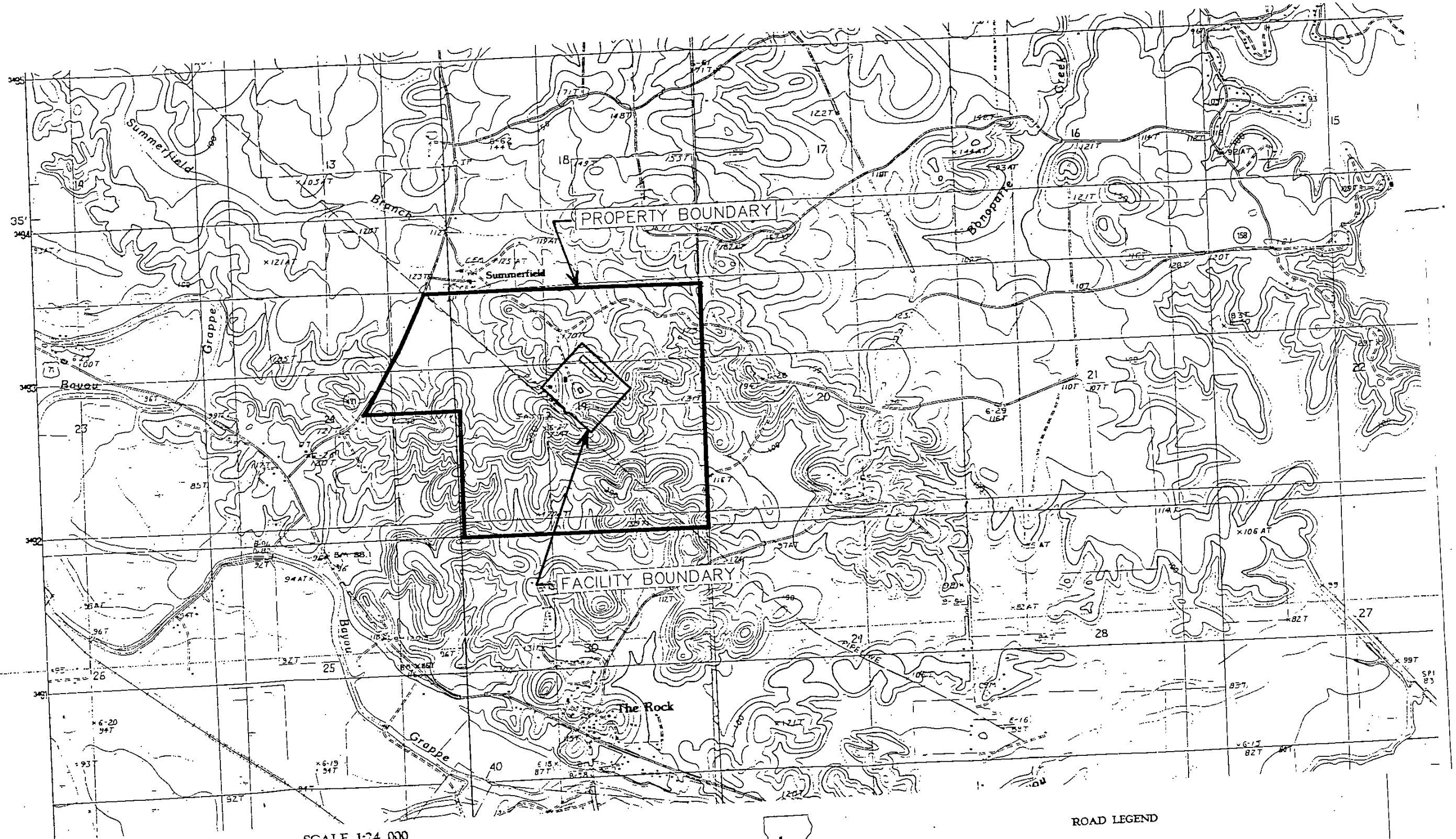
FIGURES

FIGURE 1-1

SITE PLAN

FIGURE 1-2

USGS TOPOGRAPHIC MAP



SCALE 1:24 000

MILES 1 .5 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

KILOMETERS 1 .5 0 1 2

METERS 1000 0 1000 2000

CONTOUR INTERVAL 10 FEET

SUPPLEMENTARY CONTOUR INTERVAL 5 FEET

CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 FOOT
OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT

To convert feet to meters multiply by .3048
To convert meters to feet multiply by 3.2808

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
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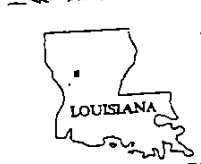
New Orleans, La. 70119



QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Verda
2 Savage Creek
3 Williana
4 Aloha
5 Dry Prong
6 Lena
7 Bowie
8 Rock Hill

ADJOINING 7.5' QUADRANGLE NAMES

ROAD LEGEND

Improved Road . . . . . .
Unimproved Road . . . . . .
Trail . . . . . .

Interstate Route U.S. Route State Route

COLFAX, LOUISIANA
SW/4 COLFAX 15' QUADRANGLE
PROVISIONAL EDITION 1985

31092-E6-TF-024

X

Appendices

APPENDIX 1-A
ASH ANALYTICAL DATA

Tables

TABLE 2-1

SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

TABLE 2-1
SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

GROUNDWATER	P1-W1	P2-W1	MW1-W1	MW2-W1	P3-W1	Trip Blank	PQL
	7/19/93	7/19/93	7/19/93	7/19/93	7/21/93	7/23/93	
VOLATILE ORGANICS - ug/L							
Acetone	ND	ND	ND	ND	ND	ND	10
Benzene	ND	ND	ND	ND	ND	ND	5
Bromodichloromethane	ND	ND	ND	ND	ND	ND	5
Bromoform	ND	ND	ND	ND	ND	ND	5
Bromomethane	ND	ND	ND	ND	ND	ND	10
2-Butanone	ND	ND	ND	ND	ND	ND	20
Carbon Disulfide	ND	ND	ND	ND	ND	ND	5
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	5
Chlorobenzene	ND	ND	ND	ND	ND	ND	5
Chloroethane	ND	ND	ND	ND	ND	ND	10
2-Chloroethylvinylether	ND	ND	ND	ND	ND	ND	10
Chloroform	ND	ND	ND	ND	ND	ND	5
Chloromethane	ND	ND	ND	ND	ND	ND	10
Dibromochloromethane	ND	ND	ND	ND	ND	ND	5
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	5
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	5
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	5
total-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	5
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	5
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	5
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	5
Ethylbenzene	ND	ND	ND	ND	ND	ND	5
2-Hexanone	ND	ND	ND	ND	ND	ND	10
Methylene Chloride	ND	ND	ND	ND	ND	ND	5
4-Methyl-2-Pentanone	ND	ND	ND	ND	ND	ND	10
Styrene	ND	ND	ND	ND	ND	ND	5
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	5
Tetrachloroethene	ND	ND	ND	ND	ND	ND	5
Toluene	ND	ND	ND	ND	ND	ND	5
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	5
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	5
Trichloroethene	ND	ND	ND	ND	ND	ND	5
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	5
Vinyl Acetate	ND	ND	ND	ND	ND	ND	10
Vinyl Chloride	ND	ND	ND	ND	ND	ND	10
Xylenes (total)	ND	ND	ND	ND	ND	ND	5

TABLE 2-1
SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

GROUNDWATER	P1-W1	P2-W1	MW1-W1	MW2-W1	P3-W1	Trip Blank	PQL
	7/19/93	7/19/93	7/19/93	7/19/93	7/21/93	7/23/93	
SEMIVOLATILE ORGANICS - ug/L							
Acenaphthene	ND	ND	ND	ND	ND		5
Acenaphthylene	ND	ND	ND	ND	ND		5
Aniline	ND	ND	ND	ND	ND		5
Anthracene	ND	ND	ND	ND	ND		5
Benzo (a) Anthracene	ND	ND	ND	ND	ND		5
Benzo (b) Fluoranthene	ND	ND	ND	ND	ND		5
Benzo (k) Fluoranthene	ND	ND	ND	ND	ND		5
Benzo (a) Pyrene	ND	ND	ND	ND	ND		5
Benzoic Acid	ND	ND	ND	ND	ND		25
Benzo (g,h,i) Perylene	ND	ND	ND	ND	ND		5
Benzyl alcohol	ND	ND	ND	ND	ND		5
4-Bromophenylphenyl ether	ND	ND	ND	ND	ND		5
Butylbenzylphthalate	ND	ND	ND	ND	ND		5
di-n-Butyl phthalate	ND	ND	ND	ND	ND		5
Carbazole	ND	ND	ND	ND	ND		5
4-Chloroaniline	ND	ND	ND	ND	ND		5
bis (2-Chloroethoxy) Methane	ND	ND	ND	ND	ND		5
bis (2-Chloroethyl) Ether	ND	ND	ND	ND	ND		5
4-Chloro-3-Methylphenol	ND	ND	ND	ND	ND		5
2-Chloronaphthalene	ND	ND	ND	ND	ND		5
2-Chlorophenol	ND	ND	ND	ND	ND		5
4-Chlorophenylphenyl ether	ND	ND	ND	ND	ND		5
Chrysene	ND	ND	ND	ND	ND		5
Dibenz (a,h) Anthracene	ND	ND	ND	ND	ND		5
Dibenzofuran	ND	ND	ND	ND	ND		5
1,2-Dichlorobenzene	ND	ND	ND	ND	ND		5
1,3-Dichlorobenzene	ND	ND	ND	ND	ND		5
1,4-Dichlorobenzene	ND	ND	ND	ND	ND		5
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND		5
2,4-Dichlorophenol	ND	ND	ND	ND	ND		5
Diethylphthalate	6	6	ND	ND	ND		5
2,4-Dimethylphenol	ND	ND	ND	ND	ND		5
Dimethyl Phthalate	ND	ND	ND	ND	ND		5
4,6-Dinitro-2-Methylphenol	ND	ND	ND	ND	ND		25
2,4-Dinitrophenol	ND	ND	ND	ND	ND		25
2,4-Dinitrotoluene	ND	ND	ND	ND	ND		5
2,6-Dinitrotoluene	ND	ND	ND	ND	ND		5
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND		5
bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND		5
Fluoranthene	ND	ND	ND	ND	ND		5
Fluorene	ND	ND	ND	ND	ND		5
Hexachlorobenzene	ND	ND	ND	ND	ND		5

TABLE 2-1
SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

GROUNDWATER	P1-W1	P2-W1	MW1-W1	MW2-W1	P3-W1	Trip Blank	PQL
	7/19/93	7/19/93	7/19/93	7/19/93	7/21/93	7/23/93	
SEMIVOLATILE ORGANICS - ug/L (continued)							
Hexachlorobutadiene	ND	ND	ND	ND	ND		5
Hexachloroethane	ND	ND	ND	ND	ND		5
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND		5
Indeno (1,2,3-cd) Pyrene	ND	ND	ND	ND	ND		5
Isophorone	ND	ND	ND	ND	ND		5
2-Methylnaphthalene	ND	ND	ND	ND	ND		5
2-Methylphenol	ND	ND	ND	ND	ND		5
4-Methylphenol	ND	ND	ND	ND	ND		5
Naphthalene	ND	ND	ND	ND	ND		5
2-Nitroaniline	ND	ND	ND	ND	ND		25
3-Nitroaniline	ND	ND	ND	ND	ND		25
4-Nitroaniline	ND	ND	ND	ND	ND		25
Nitrobenzene	ND	ND	ND	ND	ND		5
2-Nitrophenol	ND	ND	ND	ND	ND		5
4-Nitrophenol	ND	ND	ND	ND	ND		25
N-Nitrosodiphenylamine (1)	ND	ND	ND	ND	ND		5
N-Nitroso-Di-n-Propylamine	ND	ND	ND	ND	ND		5
Di-n-Octyl Phthalate	ND	ND	ND	ND	ND		5
Pentachlorophenol	ND	ND	ND	ND	ND		25
Phenanthrene	ND	ND	ND	ND	ND		5
Phenol	120	65	22	84	140		15
Pyrene	ND	ND	ND	ND	ND		5
Pyridine	ND	ND	ND	ND	ND		5
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND		5
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND		10
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND		5

TABLE 2-1
SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

GROUNDWATER	P1-W1	P2-W1	MW1-W1	MW2-W1	P3-W1	Trip Blank	PQL
	7/19/93	7/19/93	7/19/93	7/19/93	7/21/93	7/23/93	
METALS - mg/L							
Total Aluminum	0.2	2.1	2.7	0.3	32.4		0.1
Total Arsenic	ND	ND	ND	ND	ND		0.01
Total Barium	0.035	0.32	0.073	0.012	0.089		0
Total Beryllium	ND	ND	ND	ND	ND		0
Total Cadmium	ND	ND	ND	ND	ND		0.02
Total Chromium	ND	0.02	ND	ND	0.06		0.02
Total Copper	ND	0.01	ND	ND	0.03		0.01
Total Nickel	ND	ND	ND	ND	ND		0.07
Total Lead	ND	ND	ND	ND	ND		0.2
Total Antimony	ND	ND	ND	ND	ND		0.2
Total Selenium	ND	ND	ND	ND	ND		0
Total Zinc	ND	0.07	ND	0.09	0.29		0.02

TABLE 2-1
SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS

GROUNDWATER	P1-W1	P2-W1	MW1-W1	MW2-W1	P3-W1	Trip Blank	PQL
	7/19/93	7/19/93	7/19/93	7/19/93	7/21/93	7/23/93	
HPLC - ug/L							
HMX	ND	ND	ND	ND	ND		13.00
RDX	ND	ND	ND	ND	ND		14.00
1,3,5-Trinitrobenzene	ND	ND	ND	ND	ND		7.30
1,3-Dinitrobenzene	ND	ND	ND	ND	ND		4.00
Tetryl	ND	ND	ND	ND	ND		44.00
Nitrobenzene	ND	ND	ND	ND	ND		10.00
2,4,6-Trinitrotoluene	ND	ND	ND	ND	ND		7.00
2,4-Dinitrotoluene	ND	ND	ND	ND	ND		6.00
2,6-Dinitroltoluene	ND	ND	ND	ND	ND		9.40
o-Nitrotoluene	ND	ND	ND	ND	ND		12.00
m-Nitrotoluene	ND	ND	ND	ND	ND		8.00
p-Nitrotoluene	ND	ND	ND	ND	ND		8.50

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LAB

Laboratory & Analytical Business Services

300 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #1

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/9/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34353
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 2:45 PM CS
3520	11/9 @ 1:30 PM CS
8260	11/11 @ 7:53 PM CS
8270	11/9 @ 9:29 PM CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - MATRIX RECOVERY	SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	0.38	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.28	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.81	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	148.04	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.00	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	689 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.90	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

LAB

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #1

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 9:00 AM

LAB # 34353

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	QA/QC - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.01	MG/L	11/9 @ 2:55 PM - CV	SEC. 7.3 1310
FLASHPOINT	) 210	(140 F	11/10 @ 10:08 AM - CV	SW 846 1010
pH	10.13	(2 OR)12	11/9 @ 10:55 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	0.1	MG/L	11/8 @ 2:57 PM - CV	SEC. 7.3 1310

ATTEST: Ina Dugas

LAB, INC.
Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #2

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34354
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 3:05 PM: CS
3520	11/9 @ 1:20 PM: CS
8260	11/11 @ 8:29 PM: CS
8270	11/9 @ 10:41 PM: CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	0.55	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.27	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.33	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	86.53	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.50	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.50	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.30	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	2.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.10	UG/L	0.7	MG/L	689 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.30	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #2

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/9/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34354

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C RECOVERY	- MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CON'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.01	MG/L	11/8 @ 3:10 PM - CV	SEC. 7.3 1310
FLASHPOINT	> 210	<140 F	11/10 @ 10:40 AM - CV	SW 846 1010
pH	9.87	<2 OR >12	11/9 @ 10:56 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	0.01	MG/L	11/8 @ 3:15 PM - CV	SEC. 7.3 1310

ATTEST: Lisa Noyes

Laboratory & Analytical Business Services

808 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #3

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34355
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 3:20 PM CS
3520	11/9 @ 1:10 PM CS
8260	11/11 @ 9:06 PM CS
8270	11/9 @ 11:55 PM CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 251.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	0.16	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.32	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.63	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	202.51	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.90	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.00	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1 DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	699 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.90	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3139

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #3

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34355

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	QA/QC - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	2.4	MG/L	11/8 @ 3:32 PM - BJ	SEC. 7.3 1310
FLASHPOINT	> 210	/140 F	11/10 @ 10:55 AM - CV	SW 846 1010
PH	6.58	<2 OR >12	11/9 @ 10:57 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	0.01	MG/L	11/8 @ 3:32 PM - BJ	SEC. 7.3 1310

ATTEST: Ana Dojra

L A B S
Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #4

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34386
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 3:48 PM : CS
3520	11/9 @ 2:00 PM CS
8260	11/11 @ 9:42 PM : CS
8270	11/10 @ 2:21 AM : CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - MATRIX RECOVERY	SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	15.27	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.28	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.11	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	1.68	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.90	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	689 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.90	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #4

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34356

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	QA/QC - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.05	MG/L	11/9 @ 3:52 PM - BJ	SEC. 7.3 1310
FLASHPOINT	) 210	(140 F	11/10 @ 11:10 AM - CV	SW 846 1010
pH	8.97	(2 OR)12	11/9 @ 10:58 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	0.01	MG/L	11/9 @ 3:52 PM - BJ	SEC. 7.3 1310

ATTEST: Lisa Segura

LAB

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #5

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34357
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 4:00 PM CS
3520	11/9 @ 2:10 PM CS
8260	11/11 @ 10:19 PM CS
8270	11/10 @ 1:07 AM CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.091	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	23.20	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.29	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.26	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	< 0.01	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.00	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	699 /	700	UG/L	99.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.30	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #5

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34357

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE SW 846 CODE	METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.01	MG/L	11/9 @ 4:08 PM - BJ	SEC. 7.3 1310
FLASHPOINT	> 210	(140 F	11/10 @ 11:24 AM - CV	SW 846 1010
pH	10.01	(2 OR)12	11/9 @ 10:59 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	0.01	MG/L	11/9 @ 4:08 PM - BJ	SEC. 7.3 1310

ATTEST: Lisa Boggs

LAB

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #6

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34358
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 4:00 PM CS
3520	11/9 @ 1:00 PM CS
8260	11/11 @ 10:56 AM CS
8270	11/10 @ 3:33 AM CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - MATRIX RECOVERY	SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	0.27	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.27	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.53	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	< 0.01	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.90	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.90	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	689 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.90	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.90	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

LABS

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE 36

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34353

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION
WAGTE SW 846

CODE	METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1975 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.13	MG/L	11/3 @ 4:08 PM - CV	SEC. 7.3 1310
FLASHPOINT	> 210	<140 F	11/10 @ 11:43 AM - CV	SW 846 1010
pH	7.64	<2 OR >12	11/9 @ 1:00 PM - CV	SW 846 9040
REACTIVITY:T SULFIDE	5.5	MG/L	11/8 @ 4:10 PM - CV	SEC. 7.3 1310

ATTEST: [signature]

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

Sodium Azide
30gal drum
5gal bucket
lined w/ plastic

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #7

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34359
QUALITY ASSURANCE/QUALITY CONTROL # 34353

SW 846 METHOD	DATE / TIME / ANALYST
1311	11/8 @ 3:45 PM CS
3520	11/9 @ 2:30 PM CS
8260	11/12 @ 11:40 AM CS
8270	11/10 @ 4:45 AM CS

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CAS #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.65 /	5	MG/L	93.00 %
D005	7080	7440-39-3	BARIUM	0.41	0.01	MG/L	100	MG/L	10.13 /	10	MG/L	101.30 %
D006	7130	7440-43-9	CADMIUM	(0.01	0.01	MG/L	1	MG/L	0.964 /	1	MG/L	96.40 %
D007	7190	1333-82-0	CHROMIUM	0.23	0.01	MG/L	5	MG/L	5.06 /	5	MG/L	101.20 %
D008	7420	7439-92-1	LEAD	0.86	0.01	MG/L	5	MG/L	5.17 /	5	MG/L	103.40 %
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.194 /	0.2	MG/L	97.00 %
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.933 /	1	MG/L	93.30 %
D011	7760	7440-22-4	SILVER	(0.01	0.01	MG/L	5	MG/L	4.92 /	5	MG/L	98.40 %
			ORGANICS									
D018	8260	71-43-2	BENZENE	40.75	2.40	UG/L	0.5	MG/L	465 /	500	UG/L	93.00 %
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	489 /	500	UG/L	97.80 %
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	104.2 /	100	UG/L	104.20 %
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	587 /	600	UG/L	97.83 %
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9142 /	10000	UG/L	91.42 %
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	9688 /	10000	UG/L	96.88 %
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10047 /	10000	UG/L	100.47 %
D026	8270	(ALL)	CRESOL	**	3.00	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	0.32	UG/L	7.5	MG/L	10123 /	10000	UG/L	101.23 %
D028	8260	107-06-2	1,2-DICHLOROETHANE	BDL	0.24	UG/L	0.5	MG/L	471 /	500	UG/L	94.20 %
D029	8260	75-35-4	1,1-DICHLOROETHYLENE	BDL	5.40	UG/L	0.7	MG/L	689 /	700	UG/L	98.43 %
D030	8270	121-14-2	2,4-DINITROTOLUENE	BDL	5.70	UG/L	0.13	MG/L	135.1 /	130	UG/L	103.92 %
D032	8270	118-74-1	HEXACHLOROBENZENE	BDL	1.30	UG/L	0.13	MG/L	138.5 /	130	UG/L	106.54 %
D033	8270	87-68-3	HEXACHLOROBUTADIENE	BDL	0.90	UG/L	0.5	MG/L	476 /	500	UG/L	95.20 %
D034	8270	67-72-1	HEXACHLOROETHANE	BDL	1.60	UG/L	3	MG/L	2951 /	3000	UG/L	98.37 %
D035	8260	78-93-3	METHYL ETHYL KETONE	BDL	1.60	UG/L	200	MG/L	9587 /	10000	UG/L	95.87 %

L A B S Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES
LOCATION: COLFAX LA
IDENTIFICATION: SOLID SAMPLE #7

REPORT DATE: NOVEMBER 17, 1993
DATE RECEIVED: 11/8/93 @ 10:40 AM
DATE COMPLETE: 11/17/93 @ 8:00 AM

LAB # 34359

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			ORGANICS - CONT'D									
D036	8270	98-95-3	NITROBENZENE	BDL	1.90	UG/L	2	MG/L	1976 /	2000	UG/L	98.80 %
D037	8270	87-86-5	PENTACHLOROPHENOL	BDL	3.60	UG/L	100	MG/L	9755 /	10000	UG/L	97.55 %
D038	8270	110-86-1	PYRIDINE	BDL	1.90	UG/L	5	MG/L	4831 /	5000	UG/L	96.62 %
D039	8260	127-18-4	TETRACHLOROETHYLENE	BDL	1.80	UG/L	0.7	MG/L	692 /	700	UG/L	98.86 %
D040	8260	79-01-6	TRICHLOROETHYLENE	BDL	1.60	UG/L	0.5	MG/L	478 /	500	UG/L	95.60 %
D041	8270	95-95-4	2,4,5-TRICHLOROPHENOL	BDL	3.00	UG/L	400	MG/L	9935 /	10000	UG/L	99.35 %
D042	8270	88-06-2	2,4,6-TRICHLOROPHENOL	BDL	2.70	UG/L	2	MG/L	1988 /	2000	UG/L	99.40 %
D043	8260	75-01-4	VINYL CHLORIDE	BDL	0.18	UG/L	0.2	MG/L	192.4 /	200	UG/L	96.20 %

*BDL = BELOW DETECTION LIMIT. HEAVY METALS ARE REPORTED IN MG/L. ALL OTHERS ARE REPORTED IN UG/L. EPA LIMITS ARE IN MG/L. TO CONVERT FROM UG/L TO MG/L - DIVIDE UG/L BY 1000. REFER TO THE O-CRESOL, M-CRESOL, AND P-CRESOL FOR TOTAL CRESOL & MATRIX SPIKE RECOVERIES OF CRESOLS.

PARAMETER	RESULTS	UNITS/EPA LIMITS	DATE /TIME /ANALYST	METHOD
REACTIVITY:T CYANIDE	0.15	MG/L	11/8 @ 4:15 PM - CV	SEC. 7.3 1310
FLASHPOINT	) 210	(140 F	11/10 @ 12:00 PM - CV	SW 846 1010
pH	12.78	(2 OR)12	11/9 @ 11:01 AM - CV	SW 846 9040
REACTIVITY:T SULFIDE	1.3	MG/L	11/8 @ 4:19 PM - CV	SEC. 7.3 1310

ATTEST: Carolyn Chevis

LAB

Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

CONTRACTOR: LAIDLAW ENVIRONMENTAL SERVICES - COLFAX
IDENTIFICATION: G114 ROLL OFF BOX

REPORT DATE: AUGUST 10, 1993
DATE RECEIVED: 8/4/93 @ 5:00 PM
DATE COMPLETE: 8/9/93 @ 6:00 PM

LAB # 32611
QUALITY ASSURANCE/QUALITY CONTROL # 32611

SW 846 METHOD	DATE / TIME / ANALYST	
1311	8/5 @ 9:45 AM	CS
3520	8/6 @ 8:00 AM	CS
8150	8/9 @ 10:58 AM	CS
8260	8/6 @ 3:05 PM	CS
8270	8/6 @ 3:37 PM	CS

DATE SAMPLED: 8/4/93 (LABS)

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - NOVEMBER 24, 1992 EDITION

WASTE CODE	SW 846 METHOD	CASE #	PARAMETER	RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	Q A/Q C - RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVER
			HEAVY METALS									
D004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.89 /	5	MG/L	97.8
D005	7080	7440-39-3	BARIUM	0.13	0.01	MG/L	100	MG/L	9.88 /	10	MG/L	98.8
D006	7130	7440-43-9	CADMIUM	< 0.01	0.01	MG/L	1	MG/L	0.988 /	1	MG/L	98.8
D007	7190	1333-82-0	CHROMIUM	0.19	0.01	MG/L	5	MG/L	4.87 /	5	MG/L	97.4
D008	7420	7439-92-1	LEAD	0.07	0.01	MG/L	5	MG/L	4.89 /	5	MG/L	97.8
D009	7470	7439-97-6	MERCURY	0.001	0.0005	MG/L	0.2	MG/L	0.189 /	0.2	MG/L	94.5
D010	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.988 /	1	MG/L	98.8
D011	7760	7440-22-4	SILVER	< 0.01	0.01	MG/L	5	MG/L	4.89 /	5	MG/L	97.8
			PESTICIDES									
D012	8080	72-20-8	ENDRIN	BDL	1.00	UG/L	0.02	MG/L	19.63 /	20	UG/L	98.1
D013	8050	58-89-1	LINDANE	BDL	1.00	UG/L	0.4	MG/L	387 /	400	US/L	96.7
D014	8080	72-43-5	METHOXYCHLOR	BDL	1.00	UG/L	10	MG/L	9652 /	10000	UG/L	96.5
D015	8080	8001-35-2	TOXAPHENE	BDL	1.00	UG/L	0.5	MG/L	484 /	500	UG/L	96.8
D020	8080	57-74-9	CHLORDANE	BDL	1.00	UG/L	0.03	MG/L	30.7 /	30	UG/L	102.3
D031	8080	76-44-8	HEPTACHLOR	BDL	1.00	UG/L	0.008	MG/L	7.65 /	8	UG/L	95.6
			HERBICIDES									
D016	8150	94-75-7	2,4-D	BDL	1.00	UG/L	10	MG/L	953 /	1000	UG/L	95.3
D017	8150	93-76-5	2,4,5-TP (SILVEX)	BDL	1.00	UG/L	1	MG/L	1025 /	1000	UG/L	102.5
			ORGANICS									
D018	8260	71-43-2	BENZENE	BDL	2.40	UG/L	0.5	MG/L	484 /	500	UG/L	96.8
D019	8260	56-23-5	CARBON TETRACHLORIDE	BDL	3.80	UG/L	0.5	MG/L	476 /	500	UG/L	95.2
D021	8260	108-90-7	CHLOROBENZENE	BDL	1.70	UG/L	100	MG/L	105 /	100	UG/L	105.1
D022	8260	67-66-3	CHLOROFORM	BDL	6.20	UG/L	6	MG/L	619 /	600	UG/L	103.1
D023	8270	95-48-7	o-CRESOL	BDL	1.50	UG/L	200	MG/L	9848 /	10000	UG/L	98.4
D024	8270	108-39-4	m-CRESOL	BDL	1.90	UG/L	200	MG/L	10372 /	10000	UG/L	103.7
D025	8270	106-44-5	p-CRESOL	BDL	2.60	UG/L	200	MG/L	10524 /	10000	UG/L	105.2
D026	8270	(ALL)	CRESOL	**	3.00	UG/L	200	MG/L	**	**		**
D027	8270	106-46-7	1,4-DICHLOROBENZENE	BDL	3.32	UG/L	7.5	MG/L	9976 /	10000	UG/L	99.

L A B S
Laboratory & Analytical Business Services

800 W. PLAQUEMINE STREET CHURCH POINT, LOUISIANA 70525 318-684-3130

SEPTEMBER 22, 1992

CONTRACTOR: R & D INC
LAB #: 27064000
DATE RECEIVED: 9/21/92 @ 11:15 AM
DATE COMPLETED: 9/22/92 @ 8:00 AM

PARAMETER	RESULTS	UNITS/ EPA LIMITS	DATE / TIME / ANALYST
LAB #27064 - SAMPLE #1			
REACTIVITY:T CYANIDE (SEC. 7.3 1310)	0.04	MG/L	9/21 @ 5:45 PM - SS
FLASHPOINT (SW 846 1010)	> 210	<140 °F	9/21 @ 12:48 PM - CSV
REACTIVITY:T SULFIDE (SEC. 7.3 1310)	0.01	MG/L	9/21 @ 5:05 PM - CSV
LAB #27065 - SAMPLE #2			
REACTIVITY:T CYANIDE (SEC. 7.3 1310)	0.02	MG/L	9/21 @ 5:47 PM - SS
FLASHPOINT (SW 846 1010)	> 210	<140 °F	9/21 @ 1:15 PM - CSV
REACTIVITY:T SULFIDE (SEC. 7.3 1310)	0.01	MG/L	9/21 @ 5:07 PM - CSV
LAB #27066 - SAMPLE #3			
REACTIVITY:T CYANIDE (SEC. 7.3 1310)	0.17	MG/L	9/21 @ 5:50 PM - SS
FLASHPOINT (SW 846 1010)	> 210	<140 °F	9/21 @ 1:45 PM - CSV
REACTIVITY:T SULFIDE (SEC. 7.3 1310)	0.2	MG/L	9/21 @ 5:09 PM - CSV

ATTEST: Carolyn Thomas

BEST COPY

LABS
Laboratory & Analytical Business Services

RT. 4 Box 167A | Church Point, LA 70525 | (318) 684-3130

CONTRACTOR: R & D INCORPORATED
IDENTIFICATION: ASH SAMPLE A

JANUARY 29, 1992
DATE ANALYZED: 1/27/92 @ 3:37 PM
DATE COMPLETE: 1/29/92 @ 5:35 PM

LAB # 22756
QUALITY ASSURANCE/QUALITY CONTROL # 22756

TOXICITY CHARACTERISTIC LEACHATE PROCEDURE CFR 261.24 APPENDIX II - SW846 METHOD 1311 - JUNE 29, 1990 EDITION

WASTE SW 846 CODE	METHOD	CASE #	PARAMETER	CORRECTED RESULTS	DETECTION LIMIT	UNITS	EPA LIMIT	UNITS	10 A/O C RECOVERY	MATRIX SPIKE	UNITS	SPIKE % RECOVERY
			HEAVY METALS									
0004	7061	7440-38-2	ARSENIC	0.001	0.001	MG/L	5	MG/L	4.98 /	5	MG/L	99.60 %
0005	7080	7440-39-3	BARIUM	<0.01	0.01	MG/L	100	MG/L	9.99 /	10	MG/L	99.90 %
0006	7130	7440-43-9	CADMIUM	<0.01	0.01	MG/L	1	MG/L	0.998 /	1	MG/L	99.80 %
0007	7190	1333-82-0	CHROMIUM	<0.01	0.01	MG/L	5	MG/L	4.97 /	5	MG/L	99.40 %
0008	7420	7439-92-1	LEAD	<0.01	0.01	MG/L	5	MG/L	4.97 /	5	MG/L	99.40 %
[illegible]	7470	7439-97-6	MERCURY	<0.0005	0.0005	MG/L	0.2	MG/L	0.198 /	0.2	MG/L	99.00 %
[illegible]	7741	7782-49-2	SELENIUM	0.001	0.001	MG/L	1	MG/L	0.998 /	1	MG/L	99.80 %
0011	7760	7440-22-4	SILVER	<0.01	0.01	MG/L	5	MG/L	4.99 /	5	MG/L	99.80 %

ATTEST: [signature]

Must go to solidification area for stabilization by EPA approved method regardless of physical state.

-4101
-6/92 #6

TABLE 2-2

SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
VOLATILE ORGANICS - ug/kg										
Acetone	ND	11	ND	12	ND	12	ND	10	ND	10
Benzene	ND	6	ND	6	ND	6	ND	5	ND	5
Bromodichloromethane	ND	6	ND	6	ND	6	ND	5	ND	5
Bromoform	ND	6	ND	6	ND	6	ND	5	ND	5
Bromomethane	ND	11	ND	12	ND	12	ND	10	ND	10
2-Butanone	ND	22	ND	23	ND	24	ND	20	ND	20
Carbon Disulfide	ND	6	ND	6	ND	6	ND	5	ND	5
Carbon Tetrachloride	ND	6	ND	6	ND	6	ND	5	ND	5
Chlorobenzene	ND	6	ND	6	ND	6	ND	5	ND	5
Chloroethane	ND	11	ND	12	ND	12	ND	10	ND	10
2-Chloroethylvinylether	ND	11	ND	12	ND	12	ND	10	ND	10
Chloroform	ND	6	ND	6	ND	6	ND	5	ND	5
Chloromethane	ND	11	ND	12	ND	12	ND	10	ND	10
Dibromochloromethane	ND	6	ND	6	ND	6	ND	5	ND	5
1,1-Dichloroethane	ND	6	ND	6	ND	6	ND	5	ND	5
1,1-Dichloroethene	ND	6	ND	6	ND	6	ND	5	ND	5
1,2-Dichloroethane	ND	6	ND	6	ND	6	ND	5	ND	5
total-1,2-Dichloroethene	ND	6	ND	6	ND	6	ND	5	ND	5
1,2-Dichloropropane	ND	6	ND	6	ND	6	ND	5	ND	5
cis-1,3-Dichloropropene	ND	6	ND	6	ND	6	ND	5	ND	5
trans-1,3-Dichloropropene	ND	6	ND	6	ND	6	ND	5	ND	5
Ethylbenzene	ND	6	ND	6	ND	6	ND	5	ND	5
2-Hexanone	ND	11	ND	12	ND	12	ND	10	9	10
Methylene Chloride	ND	6	ND	6	ND	6	ND	5	ND	5
4-Methyl-2-Pentanone	ND	11	ND	12	ND	12	ND	10	ND	10
Styrene	ND	6	ND	6	ND	6	ND	5	ND	5
1,1,2,2-Tetrachloroethane	ND	6	ND	6	ND	6	ND	5	ND	5

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
VOLATILE ORGANICS - ug/kg (continued)										
Tetrachloroethene	ND	6	ND	6	ND	6	ND	5	ND	5
Toluene	ND	6	ND	6	ND	6	ND	5	ND	5
1,1,1-Trichloroethane	ND	6	ND	6	ND	6	ND	5	ND	5
1,1,2-Trichloroethane	ND	6	ND	6	ND	6	ND	5	ND	5
Trichloroethene	ND	6	ND	6	ND	6	ND	5	ND	5
Trichlorofluoromethane	ND	6	ND	6	ND	6	ND	5	ND	5
Vinyl Acetate	ND	11	ND	12	ND	12	ND	10	ND	10
Vinyl Chloride	ND	11	ND	12	ND	12	ND	10	ND	10
Xylenes (total)	ND	6	ND	6	ND	6	ND	5	ND	5

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
SEMIVOLATILE ORGANICS-ug/kg										
Acenaphthene	ND	360	ND	380	ND	400	ND	330	ND	330
Acenaphthylene	ND	360	ND	380	ND	400	ND	330	ND	330
Aniline	ND	360	ND	380	ND	400	ND	330	ND	330
Anthracene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzo (a) Anthracene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzo (b) Fluoranthene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzo (k) Fluoranthene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzo (a) Pyrene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzoic Acid	ND	1800	ND	1900	ND	1900	ND	1600	ND	1600
Benzo (g,h,i) Perylene	ND	360	ND	380	ND	400	ND	330	ND	330
Benzyl alcohol	ND	360	ND	380	ND	400	ND	330	ND	330
4-Bromophenylphenyl ether	ND	360	ND	380	ND	400	ND	330	ND	330
Butylbenzylphthalate	ND	360	ND	380	ND	400	ND	330	ND	330
di-n-Butyl phthalate	ND	360	ND	380	ND	400	ND	330	ND	330
Carbazole	ND	360	ND	380	ND	400	ND	330	ND	330
4-Chloroaniline	ND	360	ND	380	ND	400	ND	330	ND	330
bis (2-Chloroethoxy) Methane	ND	360	ND	380	ND	400	ND	330	ND	330
bis (2-Chloroethyl) Ether	ND	360	ND	380	ND	400	ND	330	ND	330
4-Chloro-3-Methylphenol	ND	360	ND	380	ND	400	ND	330	ND	330
2-Chloronaphthalene	ND	360	ND	380	ND	400	ND	330	ND	330
2-Chlorophenol	ND	360	ND	380	ND	400	ND	330	ND	330
4-Chlorophenylphenyl ether	ND	360	ND	380	ND	400	ND	330	ND	330
Chrysene	ND	360	ND	380	ND	400	ND	330	ND	330
Dibenz (a,h) Anthracene	ND	360	ND	380	ND	400	ND	330	ND	330
Dibenzofuran	ND	360	ND	380	ND	400	ND	330	ND	330
1,2-Dichlorobenzene	ND	360	ND	380	ND	400	ND	330	ND	330
1,3-Dichlorobenzene	ND	360	ND	380	ND	400	ND	330	ND	330

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
SEMIVOLATILE ORGANICS - ug/kg (continued)										
1,4-Dichlorobenzene	ND	360	ND	380	ND	400	ND	330	ND	330
3,3'-Dichlorobenzidine	ND	360	ND	380	ND	400	ND	330	ND	330
2,4-Dichlorophenol	ND	360	ND	380	ND	400	ND	330	ND	330
Diethylphthalate	ND	360	ND	380	ND	400	ND	330	ND	330
2,4-Dimethylphenol	ND	360	ND	380	ND	400	ND	330	ND	330
Dimethyl Phthalate	ND	360	ND	380	ND	400	ND	330	ND	330
4,6-Dinitro-2-Methylphenol	ND	880	ND	930	ND	960	ND	800	ND	800
2,4-Dinitrophenol	ND	880	ND	930	ND	960	ND	800	ND	800
2,4-Dinitrotoluene	ND	360	ND	380	ND	400	ND	330	ND	330
2,6-Dinitrotoluene	ND	360	ND	380	ND	400	ND	330	ND	330
1,2-Diphenylhydrazine	ND	360	ND	380	ND	400	ND	330	ND	330
bis (2-Ethylhexyl) Phthalate	ND	360	ND	380	ND	400	ND	330	ND	330
Fluoranthene	ND	360	ND	380	ND	400	ND	330	ND	330
Fluorene	ND	360	ND	380	ND	400	ND	330	ND	330
Hexachlorobenzene	ND	360	ND	380	ND	400	ND	330	ND	330
Hexachlorobutadiene	ND	360	ND	380	ND	400	ND	330	ND	330
Hexachloroethane	ND	360	ND	380	ND	400	ND	330	ND	330
Hexachlorocyclopentadiene	ND	360	ND	380	ND	400	ND	330	ND	330
Indeno (1,2,3-cd) Pyrene	ND	360	ND	380	ND	400	ND	330	ND	330
Isophorone	ND	360	ND	380	ND	400	ND	330	ND	330
2-Methylnaphthalene	ND	360	ND	380	ND	400	ND	330	ND	330
2-Methylphenol	ND	360	ND	380	ND	400	ND	330	ND	330
4-Methylphenol	ND	360	ND	380	ND	400	ND	330	ND	330
Naphthalene	ND	360	ND	380	ND	400	ND	330	ND	330
2-Nitroaniline	ND	880	ND	930	ND	960	ND	800	ND	800
3-Nitroaniline	ND	880	ND	930	ND	960	ND	800	ND	800

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
SEMIVOLATILE ORGANICS - ug/kg (continued)										
4-Nitroaniline	ND	880	ND	930	ND	960	ND	800	ND	800
Nitrobenzene	ND	360	ND	380	ND	400	ND	330	ND	330
2-Nitrophenol	ND	360	ND	380	ND	400	ND	330	ND	330
4-Nitrophenol	ND	880	ND	930	ND	960	ND	800	ND	800
N-Nitrosodiphenylamine (1)	ND	360	ND	380	ND	400	ND	330	ND	330
N-Nitroso-Di-n-Propylamine	ND	360	ND	380	ND	400	ND	330	ND	330
Di-n-Octyl Phthalate	ND	360	ND	380	ND	400	ND	330	ND	330
Pentachlorophenol	ND	880	ND	930	ND	960	ND	800	ND	800
Penanthrene	ND	360	ND	380	ND	400	ND	330	ND	330
Phenol	ND	360	ND	380	ND	400	ND	330	ND	330
Pyrene	ND	360	ND	380	ND	400	ND	330	ND	330
Pyridine	ND	360	ND	380	ND	400	ND	330	ND	330
1,2,4-Trichlorobenzene	ND	360	ND	380	ND	400	ND	330	ND	330
2,4,5-Trichlorophenol	ND	880	ND	930	ND	960	ND	800	ND	800
2,4,6-Trichlorophenol	ND	360	ND	380	ND	400	ND	330	ND	330

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
METALS - mg/kg										
Total Aluminum	1004	9	6230	9	7940	10	990	10	707	8
Total Arsenic	2	1	1	1	4	1	ND	1	ND	1
Total Barium	64.1	0.8	44.7	0.8	44.8	0.8	19.8	0.9	3	0.7
Total Beryllium	ND	0.5	ND	0.6	ND	0.6	ND	0.7	ND	0.5
Total Cadmium	ND	2	ND	2	ND	2	ND	3	ND	2
Hexavalent Chromium	ND	0.1	ND	0.1	ND	0.1	ND	0.01	ND	0.05
Total Copper	ND	1	2	1	3	1	ND	1	ND	1
Total Mercury	ND	0.2	ND	0.2	ND	0.1	ND	0.2	ND	0.1
Moisture, E.P.A. (wt. %)	9	1	14	1	17	1	24	1	15	1
Total Nickel	ND	8	ND	8	ND	8	ND	9	ND	7
Total Lead	ND	20	ND	20	ND	20	ND	30	ND	20
Total Antimony	ND	20	ND	20	ND	20	ND	30	ND	20
Total Selenium	1.3	0.9	ND	0.9	ND	.1	ND	1	ND	0.8
Total Zinc	ND	2	6	2	6	2	ND	3	2	2

TABLE 2-2
SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS

SOIL	S-1 @ 6'		SP-1 @ 6'		SMW1 @ 5.6'		SP-2 @ 4'		SMW2 @ 4'	
	6/7/93		6/7/93		6/15/93		6/29/93		7/19/93	
	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL	RESULTS	PQL
HPLC - mg/kg										
HMX	ND	2.20	ND	2.20	ND	2.20	ND	2.20	ND	2.2
RDX	ND	1.00	ND	1.00	ND	1.00	ND	1.00	ND	1
1,3,5-Trinitrobenzene	ND	0.25	ND	0.25	ND	0.25	ND	0.25	ND	0.25
1,3-Dinitrobenzene									ND	0.25
Tetryl									ND	0.65
2,4,6-Trinitrotoluene	ND	0.25	ND	0.25	ND	0.25	ND	0.25	ND	0.25
2,4-Dinitrotoluene	ND	0.25	ND	0.25	ND	0.25	ND	0.25	ND	0.25
2,6-Dinitroltoluene	ND	0.65	ND	0.26	ND	0.26	ND	0.26	ND	0.26
Total Organic Carbon (mg/kg)	76	10	210	10	160	10	337	10		

TABLE 2-3

ORGANIC LEACHING MODEL - VHS INPUT

TABLE 2-3

LAIDLAW ENVIRONMENTAL SERVICES (THERMAL TREATMENT), INC.
ORGANIC LEACHING MODEL
VHS MODEL INPUT

TARGET COMPOUND	CONCENTRATION IN WASTE (MG/KG)	WATER SOLUBILITY (MG/L)	PREDICTED COMPOUND CONCENTRATION IN LEACHATE (MG/L)
RDX	0.496	60	0.006326729
HMX	3.45	N/A	0
NITROBENZENE	2.41	1,900	0.067046316
BENZENE	0.005	1,780	0.000992431
ETHYLBENZENE	0.005	152	0.000396389
1, 3 DINITROBENZENE	0.496	469	0.013623111
1, 3, 5 TRINITROBENZENE	0.488	350	0.012080316
TRINITROTOLUENE	0.456	200	0.009363853
2, 4 DINITROTOLUENE	0.424	270	0.009968848
2, 6 DINITROTOLUENE	0.524	270	0.011507939
TOLUENE	0.005	515	0.000624882
XYLENE	0.005	187	0.000427816
TETRYL	0.731	INSOLUBLE	0
METHYL ETHYL KETONE	0.01	27,500,000	0.057978018
ACETONE	0.01	MISCIBLE	0.01

TABLE 2-4

VHS MODEL - PAD BREACH SCENARIO

TABLE 2-4

LAIDLAW ENVIRONMENTAL SERVICES (THERMAL TREATMENT), INC.

VERTICAL/HORIZONTAL SPREAD MODEL

PAD BREACH SCENARIO

TARGET COMPOUND	CONCENTRATION IN WASTE (MG/KG)	WATER SOLUBILITY (MG/L)	COMPOUND CONCENTRATION IN LEACHATE (MG/L)	PREDICTED COMPOUND CONCENTRATION AT COMPLIANCE POINT (MG/L)	STANDARD FOR COMPARISON (MG/L)
RDX	0.496	60	0.006326729	0.0000000706	0.1
HMX	3.45	?	0	?	5
NITROBENZENE	2.41	1,900	0.067046316	0.0000000007	3
BENZENE	0.005	1,780	0.000992431	0.0000000111	0.005
ETHYLBENZENE	0.005	152	0.000396389	0.0000000044	0.7
1, 3 DINITROBENZENE	0.496	469	0.013623111	0.000000152	3
1, 3, 5 TRINITROBENZENE	0.488	350	0.012080316	0.0000001348	3
TRINITROTOLUENE	0.456	200	0.009363853	0.0000001045	3
2, 4 DINITROTOLUENE	0.424	270	0.009968848	0.0000001112	0.5
2, 6 DINITROTOLUENE	0.524	270	0.011507939	0.0000001284	0.5
TOLUENE	0.005	515	0.000624882	0.000000007	1
XYLENE	0.005	187	0.000427816	0.0000000048	10
TETRYL *	0.731	INSOLUBLE	0	0	N/A
METHYL ETHYL KETONE	0.01	27,500,000	0.057978018	0.0000006472	1771 mg/kg/d
ACETONE	0.01	MISCIBLE	0.01	0.0000001116	100 mg/kg/d
ALUMINUM	7940	N/A	7940	0.07429	0.2
ANTIMONY	30	N/A	30	0.0002807	0.006
BARIUM	1003	N/A	1003	0.01119	2
BERYLLIUM	1.3	N/A	1.3	0.00001451	0.004
CHROMIUM	219	N/A	219	0.002445	0.1
COPPER	78674	N/A	78674	0.878	1.3
LEAD	1633	N/A	1633	0.01823	0.3
MERCURY	0.42	N/A	0.42	0.000004689	0.002
NICKEL	49.1	N/A	49.1	0.0005481	0.1
SELENIUM	3.6	N/A	3.6	0.00004019	0.05
ZINC	551	N/A	551	0.006151	5

TABLE 2-5

VHS MODEL - SURFACE DEPOSITION SCENARIO

TABLE 2-5

LAIDLAW ENVIRONMENTAL SERVICES (THERMAL TREATMENT), INC.
VERTICAL/HORIZONTAL SPREAD MODEL
SURFACE DEPOSITION SCENARIO

TARGET COMPOUND	ANNUAL DEPOSITION RATE (GM/SQ. M)	ANNUAL VOLUME (CC)	ASSUMED CONCENTRATION IN LEACHATE (MG/L)	PREDICTED COMPOUND CONCENTRATION AT COMPLIANCE POINT (MG/L)	STANDARD FOR COMPARISON (MG/L)
ALUMINUM	1133.76	0.042	0.98	6.0280000E-11	0.2
ANTIMONY	15.12	0.00023	1.75	5.8950000E-13	0.006
BARIUM	906.24	0.02589	7135.75	2.7040000E-07	2
BERYLLIUM	0.151	0.00001	0.2	2.9280000E-15	0.004
CHROMIUM	0.106	0.000001474	0.834	1.8000000E-15	0.1
COPPER	15.12	0.00017	0.33	8.2160000E-14	1.3
LEAD	140.52	0.00124	23	4.1770000E-11	0.3
MERCURY	43.8	0.00032	53	2.4830000E-11	0.002
NICKEL	16.62	0.00019	3.6	1.0010000E-12	0.1
SELENIUM	453.12	0.00946	3567.87	4.9430000E-08	0.05
ZINC	15.12	0.00021	1.6	4.9210000E-13	5

APPENDIX 2-A

GEOTECHNICAL SOIL BORINGS

GEOTECHNICAL INVESTIGATION

FOR

R&D FABRICATING AND MANUFACTURING, INC.

COLFAX, LOUISIANA

Prepared for:

Laidlaw Environmental Services, Inc.
Post Office Box 210799
Columbia, SC 29221

File No.: 3993(SE)

April 6, 1993

RECEIVED
APR 8 1993
by ENGINEERING DEPT.

OFFICE PHONES:
318 443-7429
318 442-9879
FAX: 318 443-1305

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

April 6, 1993

File No.: 3993(SE)

Laidlaw Environmental Services, Inc.
Post Office Box 210799
Columbia, SC 29221

Attn: Mr. Samuel R. Moore, P.E.

Re: Geotechnical Investigation: R&D Fabricating And Manufacturing, Inc., Colfax, Louisiana

Gentlemen,

We enclose our Geotechnical Investigation Report for the above referenced project.

It was a pleasure to serve you and if we can be of further assistance, please call on us.

Very truly yours,

GEOTECHNICAL TESTING LABORATORY, INC.

G.B. Mitchell, P.E.
La. Reg. No. 10318

3cc: Laidlaw Environmental Services, Inc.
Attn: Mr. Samuel Moore, P.E.

NJG/tsx

STATE OF LOUISIANA
G. B. MITCHELL
REG. No. 10318
REGISTERED
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients. And authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

GEOTECHNICAL INVESTIGATION

FOR

R & D FABRICATING & MANUFACTURING, INC.

COLFAX, LOUISIANA

GENERAL:

This study was authorized by Mr. Samuel R. Moore, P.E. with Laidlaw Environmental Services, Inc., Columbia, South Carolina.

The scope of this study was to explore the subsurface conditions of a proposed construction site for the purpose of identifying soil strata and characteristics. Methods commonly employed in the industry were utilized to obtain and preserve samples and perform tests as specified by applicable testing standards. Only that work specifically authorized by the client has been performed.

FIELD OPERATIONS:

The subsurface exploration at the site consisted of one 25½-foot soil boring, one 15½-foot soil boring and four 10½-foot soil borings drilled on March, 29, 30 and 31, 1993. Boring G was inaccessible and was not drilled.

A truck mounted auger was used to advance the borings and to obtain samples for laboratory evaluation.

Standard, thin walled, seamless Shelby Tube samplers were used to obtain samples of cohesive materials. These specimens were

taken at intermediate intervals as the borings were advanced, but never further than five feet apart.

Those soils which contained enough cohesionless material to prevent recovery of samples for laboratory testing were evaluated by means of the Standard Penetration Test. This test consists of determining the number of blows required by a 140-pound hammer dropped 30 inches to achieve a one-foot penetration of the soil. This number is then related to the existing density and/or strength of the insitu material. This test is performed in accordance with ASTM D 1586-84 and results are reported accordingly.

All samples were logged, sealed and packaged in the field to protect them from disturbance and maintain their insitu moisture content during transportation to our laboratory.

The location of the test borings (Boring Location Diagram) and the results of our boring program (Logs of Borings) are enclosed with this report.

LABORATORY TESTING:

Upon return to our laboratory, selected samples were subjected to standard laboratory tests as defined by ASTM D 2216, D 2166-85 and D 4318.

The Atterberg Limits and insitu unit weight and moisture content of the different subsurface soils were determined. These were used to classify the soils according to the

Unified Soil Classification and to evaluate their potential for volumetric change.

The results of our laboratory tests are shown on the respective Logs of Borings.

SITE AND SOIL CONDITIONS:

The site is wooded (some timber has been cut) with about 25 to 30 feet of relief. The general subsurface stratigraphy is typical of the area under consideration, is nonuniform and consists of several inches of gray sandy loam topsoil overlying reddish brown, red, and/or gray sands, clayey sands, sandy clays and/or clays. Sand pockets and iron oxide staining were encountered throughout. Because of the nonuniformity, no further descriptions are attempted here but the stratigraphy is accurately depicted on the Logs of Borings.

The borings were advanced without the use of drilling fluid in order to accurately determine groundwater conditions. At time of drilling no groundwater was encountered and after a short time lapse the borings remained dry and uncaved. There was seepage occurring, however, in several areas of the lower elevations on the sides of the hills. This seepage is quite likely from recent fairly heavy seasonal rains. It is not expected to influence foundation construction nor performance. From past experience with soils in this area we feel that a

groundwater table exists not very far below the termination depth of the deepest boring (25½ feet).

All of these soils are of alluvial deposition and the deeper soils are highly preconsolidated (probably from a combination of desiccation and overburden pressures which have been removed in past geologic times). There is also some probable cementation of the more sandy soils. Consequently, essentially no settlements of the undisturbed soils are anticipated.

Results of the Atterberg Limits tests indicate that the upper sandy soils possess only moderate volume change (shrink/swell) potential that may occur as a result of seasonal moisture variations. Although the deeper clay soils have very high plasticity indices (PI), some swell potential should never be realized since the site is in an area of fairly high year-round rainfall which tends to maintain an equilibrium soil moisture.

ANALYSIS AND RECOMMENDATIONS:

The only positive method to prevent distress to a grade-supported slab when underlain by expansive clay soils is to structurally suspend the slab and isolate it from the clays. The large size (55' x 700') of the proposed structure for this project and the intended usage of the structure almost certainly renders a suspended foundation not economically feasible. We understand that considerable fill will be REQUIRED TO ACHIEVE FINISH FLOOR ELEVATION. IF LOW

plasticity material is used as fill, particularly if the fill thickness is uniform, differential slab movement from heave can be minimized.

We understand that the soils from the area of Boring A can be used as fill. The upper 5 feet of soil in this area is essentially non-plastic and would make excellent under-slab fill. Even if blended with the underlying high-plasticity clays, suitable fill can result. A blend of all of the soil to a depth of 15 feet was prepared and Atterberg Limits tests performed. The Liquid Limit (LL) was 37 and the Plasticity Index (PI) was 23. A Standard Proctor moisture-density curve for this blend is a part of this report.

We assume that a balanced cut-and-fill operation will be performed within the building limits prior to placing imported fill (from Boring A area). This will result in a uniform imported fill thickness, which is certainly desirable. We also assume that the fill thickness will be such that the structural footings will be situated in the fill.

Roof and wall loads may be supported by continuous or individual footings situated at any convenient depth (at least 2 feet) below finished floor elevation. The footings should be constructed so as to act monolithically with the fill-supported floor slab and should be sized utilizing an allowable load-bearing value of 3000 psf. This value is with

respect to shear strength (soil failure), contains a factor of safety of not less than 3, and assumes that the fill is compacted to at least 95 percent of Standard Proctor density at, or near, optimum moisture content. If tree removal has occurred or will be required, the backfill of stump holes should receive the same degree of compaction.

Under this loading total settlement of the fill should not exceed 1 inch with 1/2 inch occurring differentially (between adjacent individual footings or within a 10-foot section of continuous footing). Approximately one half of this settlement should occur during construction. The remaining long-term settlement of 1/2 inch (1/4 inch occurring differentially) should be tolerable.

LIMITATIONS:

The foregoing is based on analyses which presume the condition of the soil properties in the area around the borings to have a normally uniform variation of conditions revealed by the borings. Professional judgements and recommendations presented in this report are based partly on evaluations of technical information gathered, partly on our understanding of the characteristics of the facilities being planned and partly on our experience with the subsurface conditions in the area. We do not guarantee the performance of the project in any respect other than that our engineering work and the judgement rendered meet the standards and care of our profession.

Should any unusual conditions be encountered during construction, this office should be contacted immediately so that further investigation and supplemental information can be given.

GEOTECHNICAL TESTING LABORATORY, INC.

Analysis by:

G. B. Mitchell, P.E.

NJG/trx

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : A
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
		3		8			N/P	Loose Reddish Brown Sand
		7		6				
5		10		12		29	4	Loose Yellowish Red and Gray Clayey Sand
								Hard Gray and Yellowish Brown Clay w/small sand pockets and iron oxide staining
10		188		20				
15		58		24				Becomes red and gray w/yellow streaks
20		61		25		63	40	
25		65		23				
								Bottom @ 25½ feet
30								
35								
40								
45								
50								

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : B
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
		7		17		48	32	Soft to Medium Yellowish Red and Gray Sandy Clay w/iron oxide staining
			0.83	19	102			
5			0.48	18	105	32	16	Becomes more gray and sandy
			2.91	32	84			Very Stiff to Hard Gray and Yellowish Brown Clay w/small sand pockets and iron oxide staining
10			4.80	27	91	67	40	
								Becomes red and gray w/yellow streaks
15			6.95	22	95			
								Bottom @ 15½ feet
20								
25								
30								
35								
40								
45								
50								

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : C
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
	X	3		15			N/P	Loose Reddish Brown Sand
	X	13		20		57	40	Stiff to Very Stiff Reddish Brown Sandy Clay
5	X	16		15		29	4	
	X	10		27			N/P	Loose to Firm Gray Sand
10	X	22		19				Becomes red and gray w/yellow streaks
								Bottom @ 10½ feet
15								
20								
25								
30								
35								
40								
45								
50								

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : D
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
		9		25		78	56	Medium to Hard Gray and Reddish Brown Clay w/small sand pockets and iron oxide staining
			2.55	16	101			
5		57		20				
		59		15		64	40	
10			5.04	29	88			Becomes red and gray w/yellow streaks
								Bottom @ 10½ feet
15								
20								
25								
30								
35								
40								
45								
50								

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : E
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
	X	8		22		46	30	Stiff Reddish Brown Sandy Clay
			1.37	21	98	39	20	
5			2.73	28	86			Very Stiff to Hard Gray and Yellowish Brown Clay w/small sand pockets and iron oxide staining
			4.82	28	90	66	42	
10			4.21	25	93			
								Bottom @ 10½ feet
15								
20								
25								
30								
35								
40								
45								
50								

GEOTECHNICAL TESTING LABORATORY, INC.

LOG OF BORING

PROJECT : R&D Fabricating And Manufacturing, Inc.
LOCATION : Colfax, Louisiana
CLIENT : Laidlaw Environmental Services, Inc.

Boring : P
File : 3993(SE)
Date : 3/29/93

Dry Augered
No Water Encountered
Hole Remained Open and Uncaved

DEPTH (FEET)	SAMPLE	Std Pen (bl/ft)	U.C. (tsf)	M.C. %	Dens. (pcf)	LL %	PI %	Description of Stratum
0								Gray Sandy Loam Topsoil
			0.32	31	102	47	30	Medium to Stiff Reddish Brown Sandy Clay
			1.23	29	96			
5			2.65	31	83	68	47	Very Stiff to Hard Gray and Yellowish Brown Clay w/small sand pockets and iron oxide staining
			3.61	25	88			
10	X	51		23		66	43	Becomes red and gray w/yellow streaks
								Bottom @ 10½ feet
15								
20								
25								
30								
35								
40								
45								
50								

FICE PHONES:
3 443-7429
[illegible]42-9879

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

April 2, 1993

File No: 3993(SE)

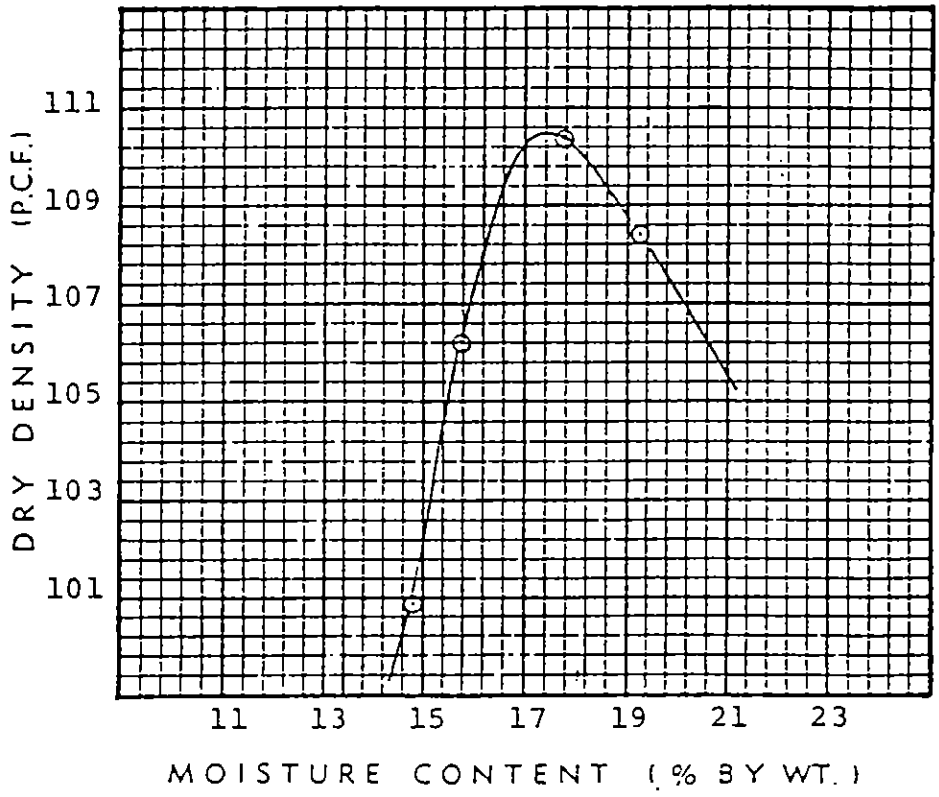
1st Report

Description : Moisture Density Relations of Soil

Project : R & D Fabricating & Manufacturing, Inc., Pollock, La.

Contractor : None

Reported To : Laidlaw Environmental Services, Inc., P. O. Box 210799, Columbia, S.C.



Method of Tests: ASTM D698 Method A, D1140, D4318
Soil Source : Composite From 0' - 15', Boring A
Soil Type : Reddish Brown & Gray Sandy Clay
Max. Dry Dens. : 110.5 lbs/cu ft
Optimum Moist. : 17.4 percent
Soil Classification : CL
Liquid Limit (LL) : 37
Plasticity Index (PI): 23

Remarks: 50.1% Passing No. 200 Sieve.

GEOTECHNICAL TESTING LABORATORY, INC.

By Ken Gaska

lcc: Laidlaw Environmental

KRG/tjw

FFICE PHONES:
18 443-7429
3 142-9879

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

April 2, 1993

File No: 3993(SE)

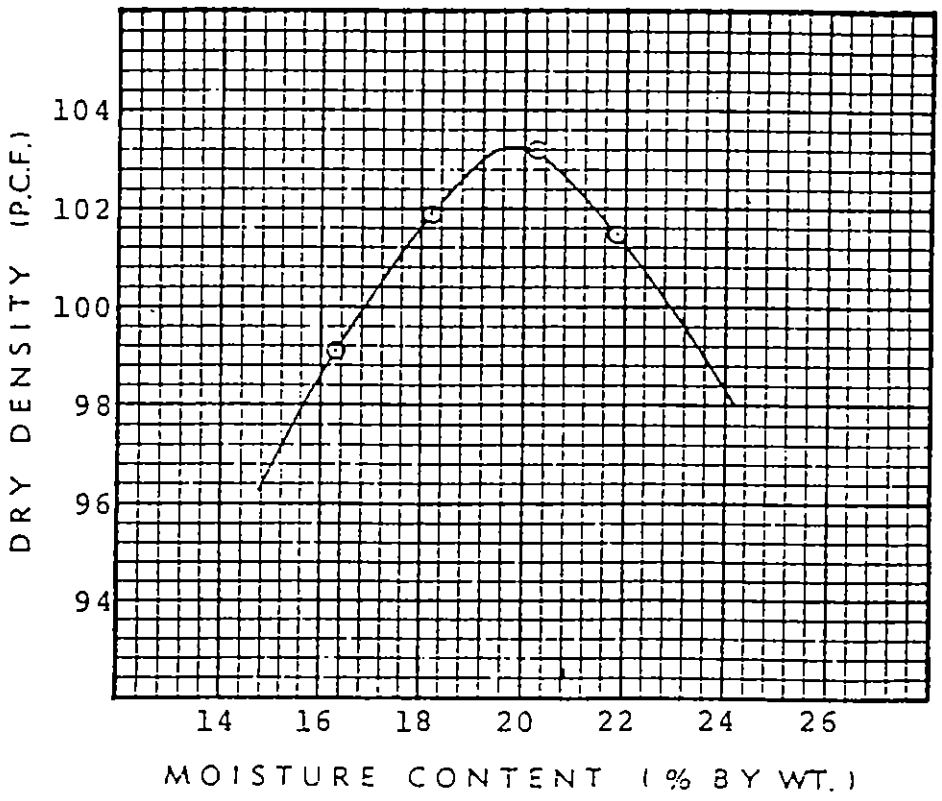
2nd Report

Description : Moisture Density Relations of Soil

Project : R & D Fabricating & Manufacturing, Inc., Pollock, La.

Contractor : None

Reported To : Laidlaw Environmental Services, Inc., P. O. Box 210799, Columbia, S.C.



Method of Tests: ASTM D698 Method A, D1140, D4318
Soil Source : Composite From 0' - 15', Boring B
Soil Type : Gray & Brown Clay w/traces of Sand
Soil Classification : CH
Max. Dry Dens. : 103.2 lbs/cu ft
Liquid Limit (LL) : 54
Optimum Moist. : 19.2 percent
Plasticity Index (PI): 35

Remarks: 69.6% Passing No. 200 Sieve.

GEOTECHNICAL TESTING LABORATORY, INC.

By Ken Gousha

lcc: Laidlaw Environmental

KRG/tjw

APPENDIX 2-B

SOIL BORINGS AND WELL LOGS

VIROGROUP WELL LOG

WELL NUMBER: P-1

PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: B59
DRILLING METHOD: HOLLOW STEM\MUD ROTARY
WEATHER: SUNNY, TEMP. 95F+
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 6/4/93 DATE COMPLETED: 7/21/93

FIELD BOOK NO.: ALP-1
TOTAL DEPTH: -145.0'
GROUND SURFACE ELEVATION: 139.0'
SHEET: OF:

STATIC WATER LEVEL (BLS)		
WD-While Drilling		AB-After Boring
Depth(ft)	-91.42 AB	-91.42 AB
Time	0712	0724
Date:	07/12/93	07/13/93

DEPTH	SOIL SAMPLES	SAMPLE RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVA * 100PPM	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
3.0										
2.0										
1.0										
0.0								TOP SOIL AND CLAY, with trace of silt; gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
1.0										
2.0					S			SANDSTONE, very silty, pale yellowish brown 10YR 6/2, very fine.		
3.0					V					
4.0								SILTY CLAY, pale yellowish brown, 10 YR 6/2.		
5.0			S1							
6.0										
7.0			S1							

8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0

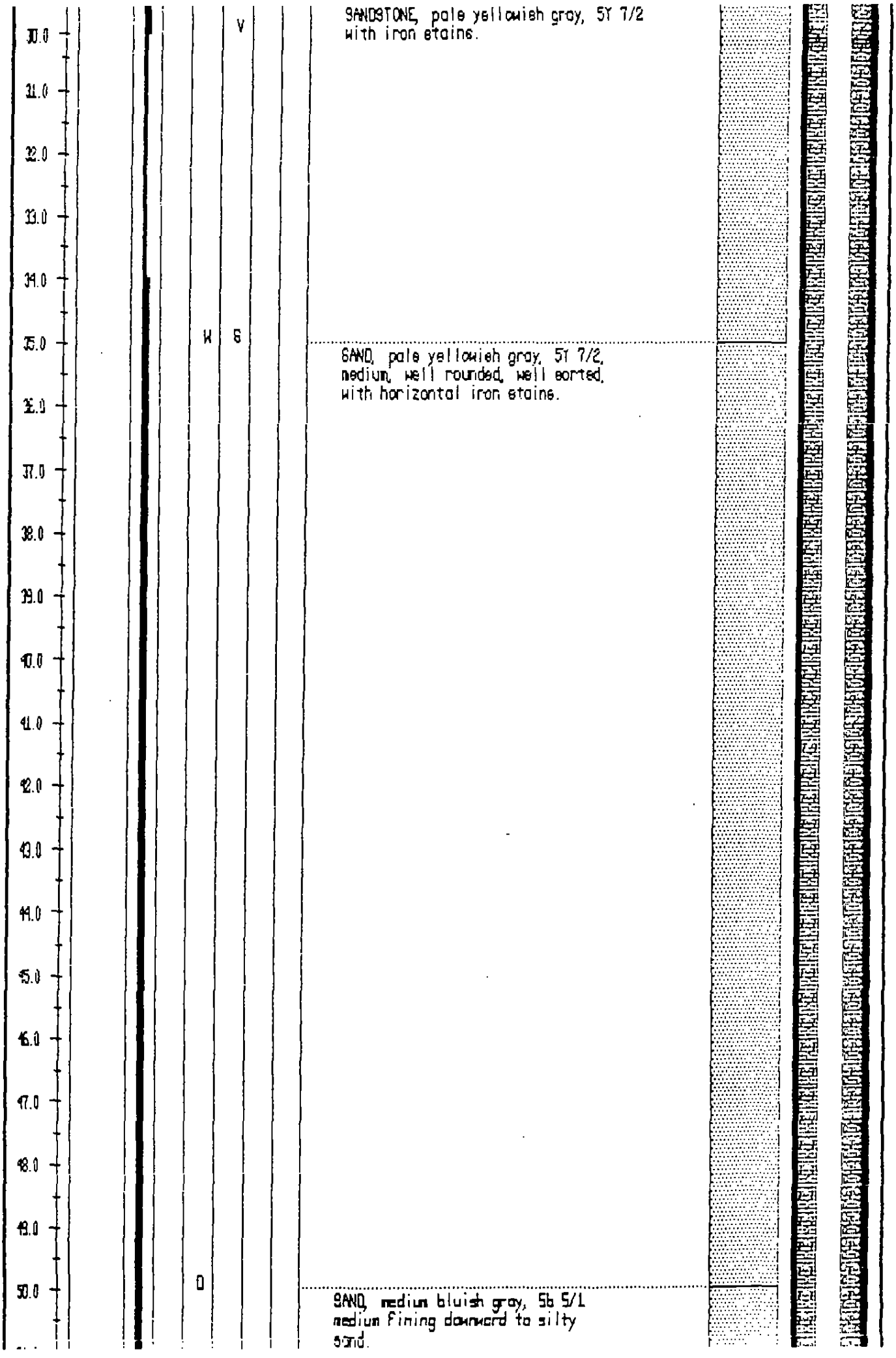
V

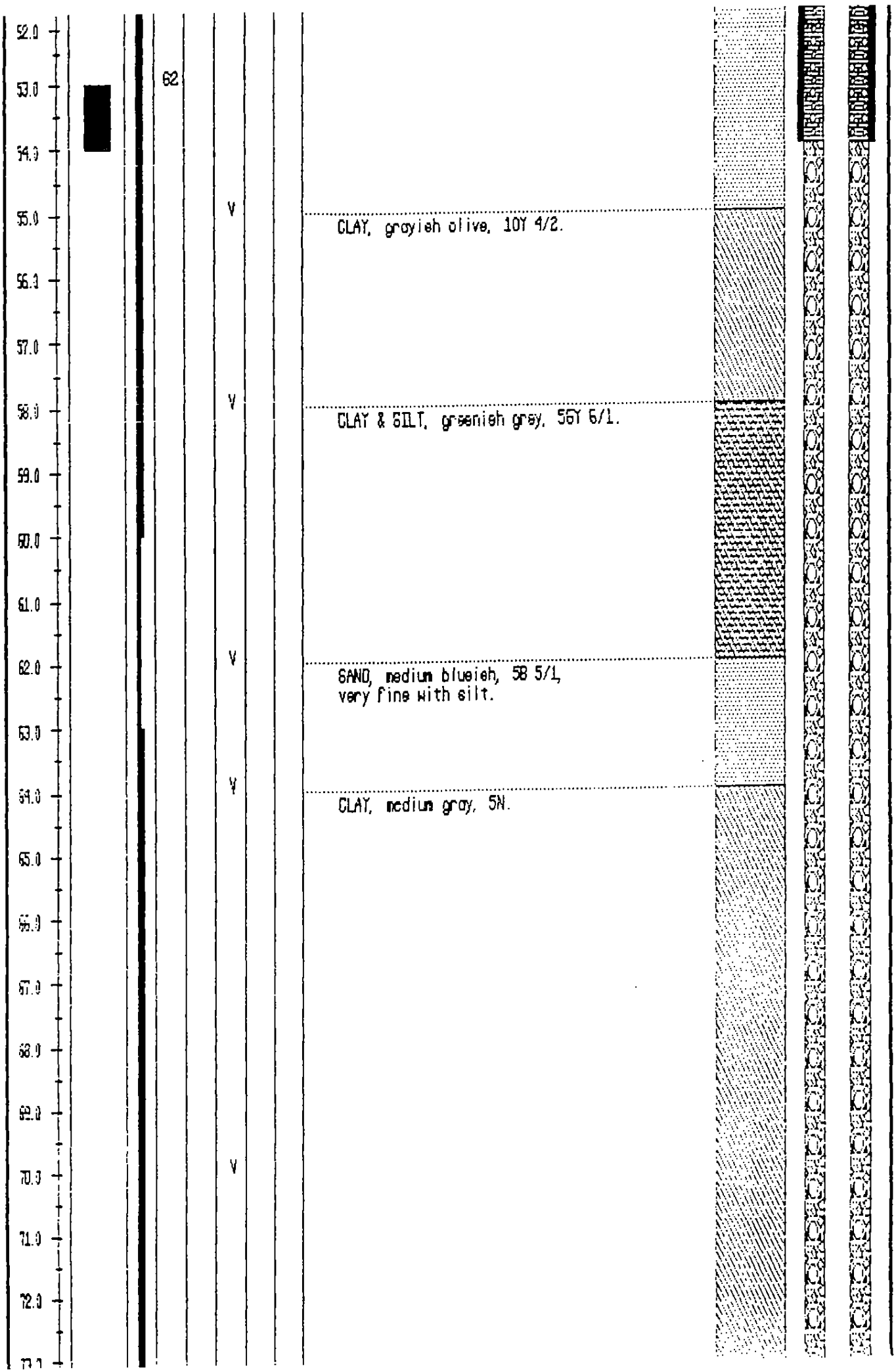
D

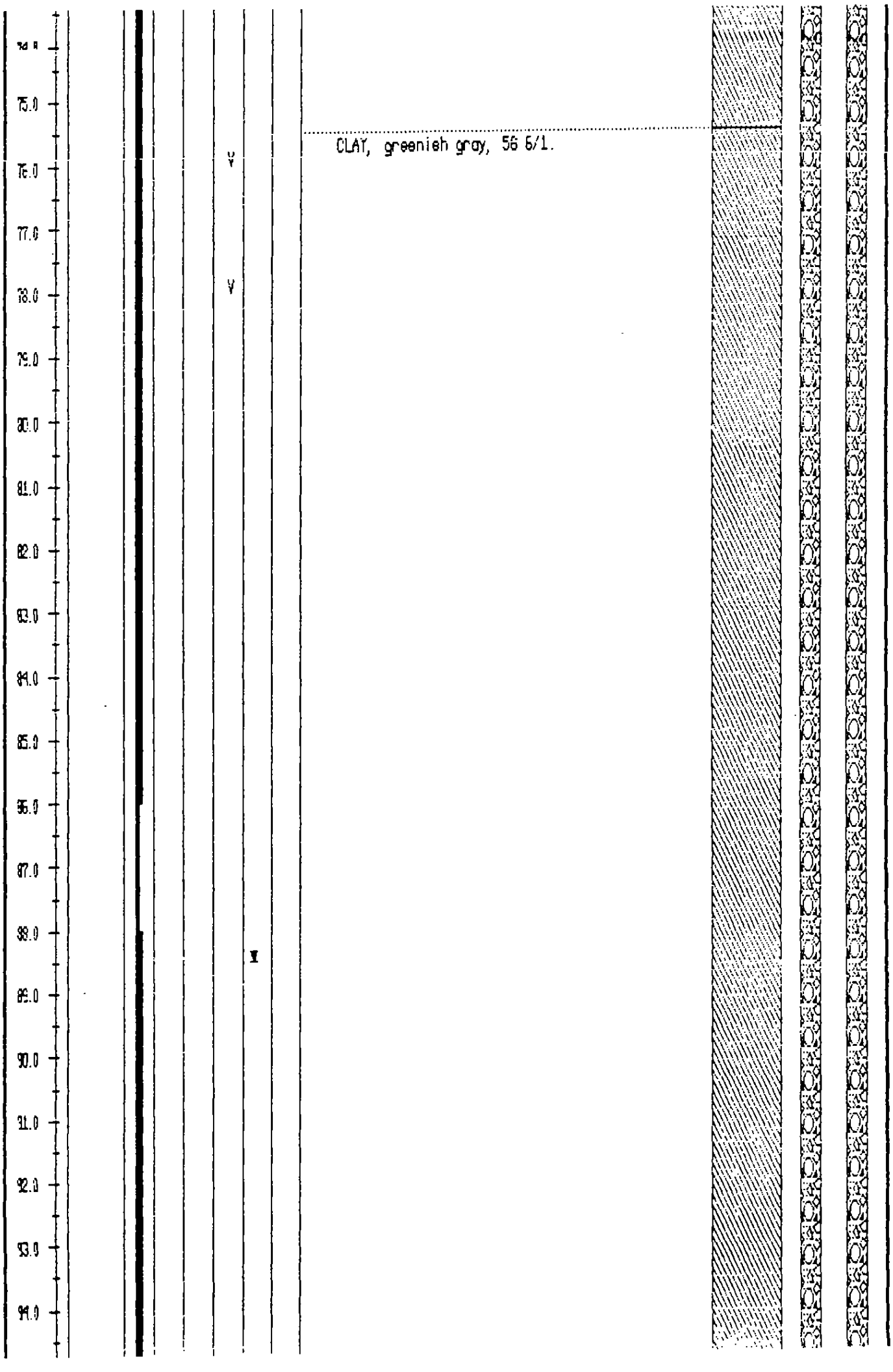
V

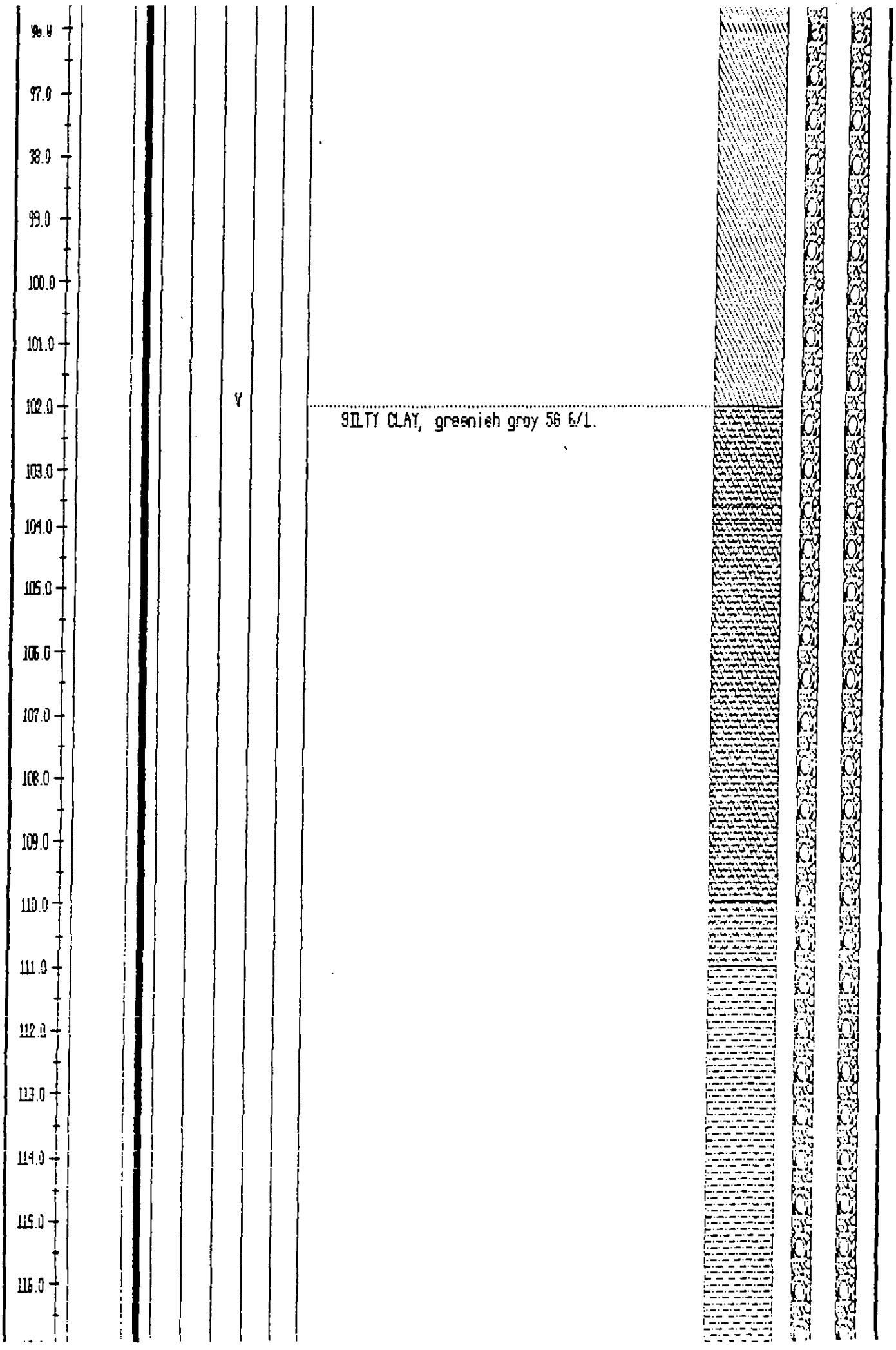
SILTY CLAY, light olive gray, 5Y 6/1, with horizontal iron stains.

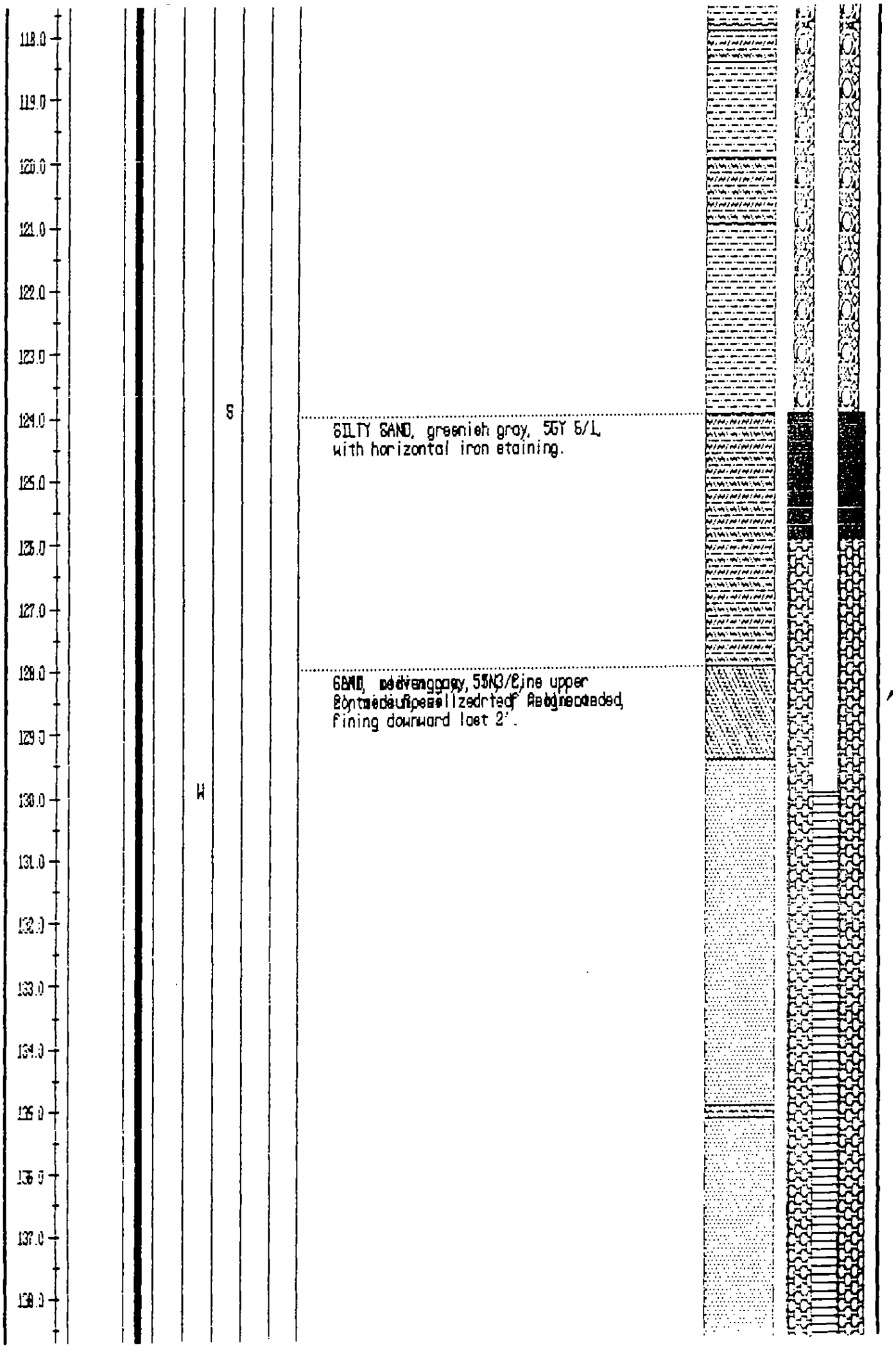
SILTY CLAY, dark greenish grey, 5G 4/1.

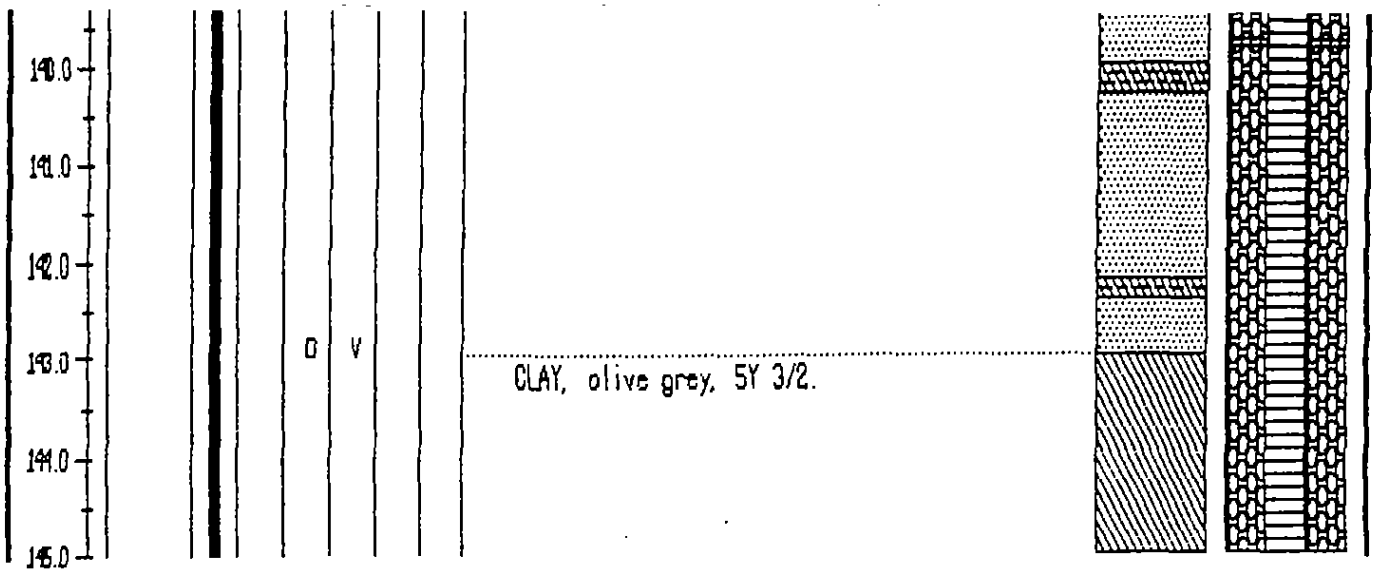

30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
V
W
S
D
SANDSTONE, pale yellowish gray, 5Y 7/2 with iron stains.
SAND, pale yellowish gray, 5Y 7/2, medium, well rounded, well sorted, with horizontal iron stains.
SAND, medium bluish gray, 5b 5/1 medium fining downward to silty sand.


52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
82
CLAY, grayish olive, 10Y 4/2.
CLAY & SILT, greenish gray, 5GY 6/1.
SAND, medium bluish, 5B 5/1,
very fine with silt.
CLAY, medium gray, 5N.


75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
CLAY, greenish gray, 5G 6/1.


96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
116.0
V
SILTY CLAY, greenish gray 5G 6/1.


118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
130.0
131.0
132.0
133.0
134.0
135.0
136.0
137.0
138.0
S
W
SILTY SAND, greenish gray, 5GY 6/1, with horizontal iron staining.
fining downward last 2'.


140.0
141.0
142.0
143.0
144.0
145.0
D
V
CLAY, olive grey, 5Y 3/2.

VIROGROUP WELL LOG

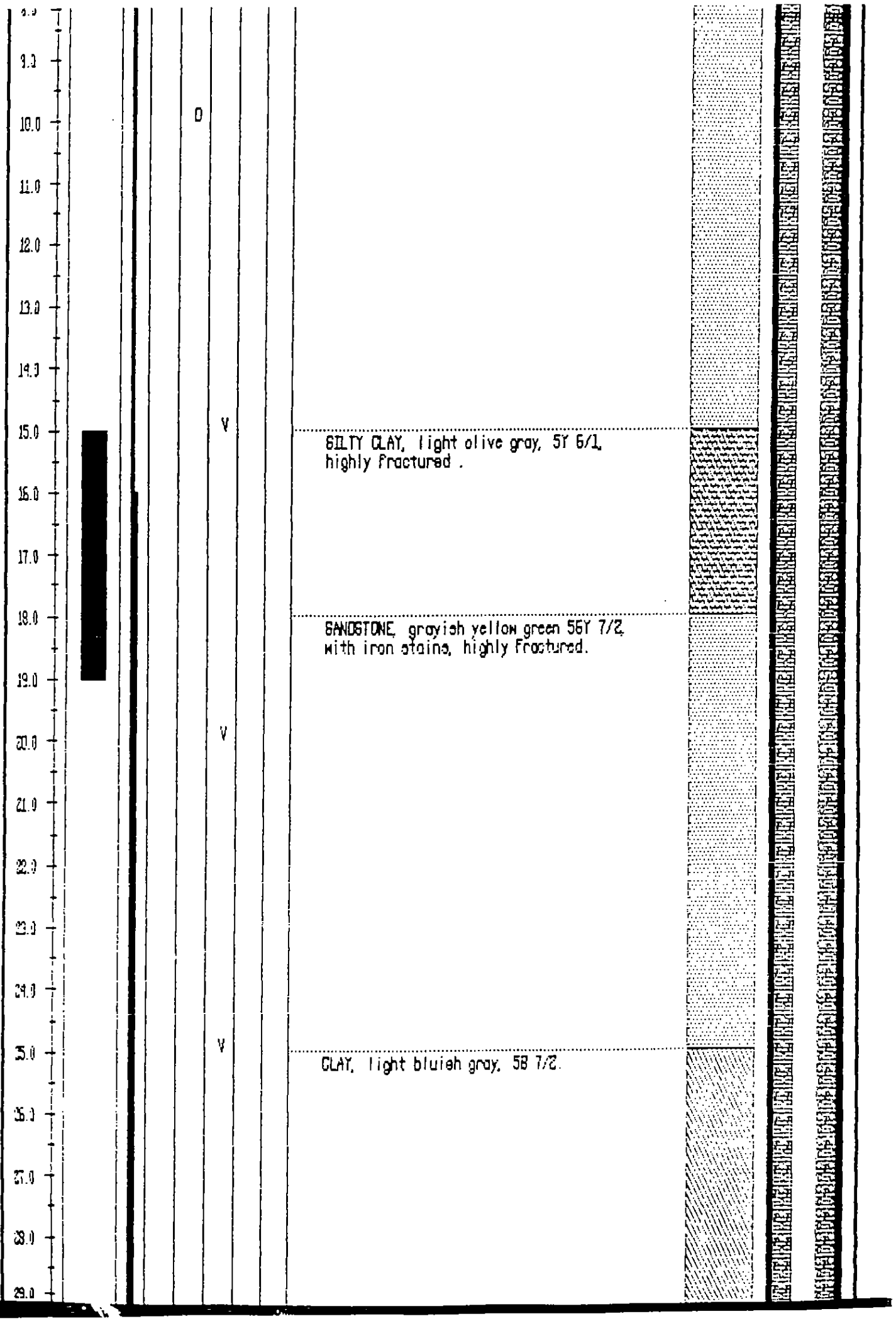
WELL NUMBER: P-2

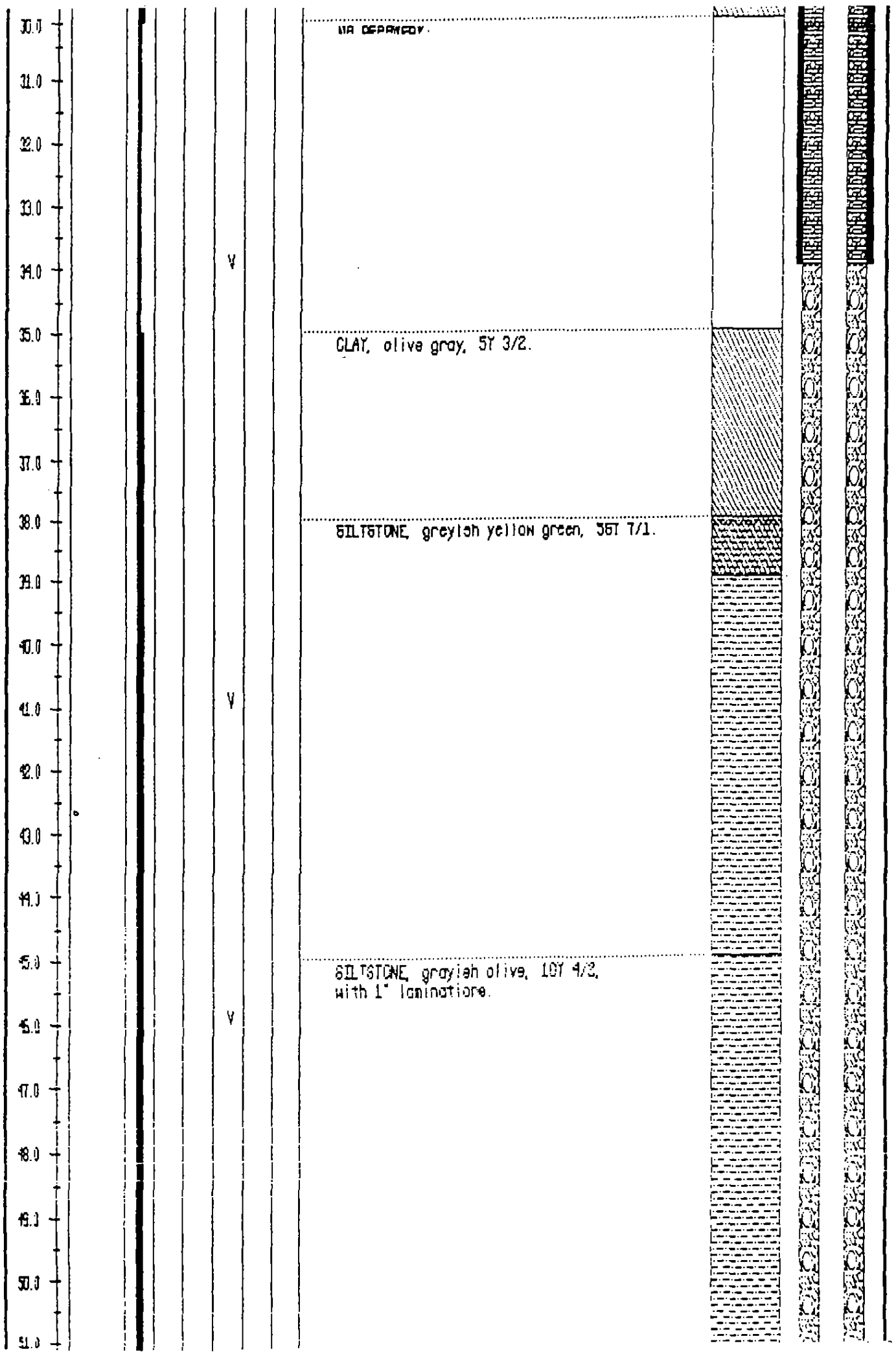
PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: 859
DRILLING METHOD: HOLLOW STEM\MUD ROTARY
WEATHER: SUNNY, TEMP. 95F+
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 6/29/93 DATE COMPLETED: 7/22/93

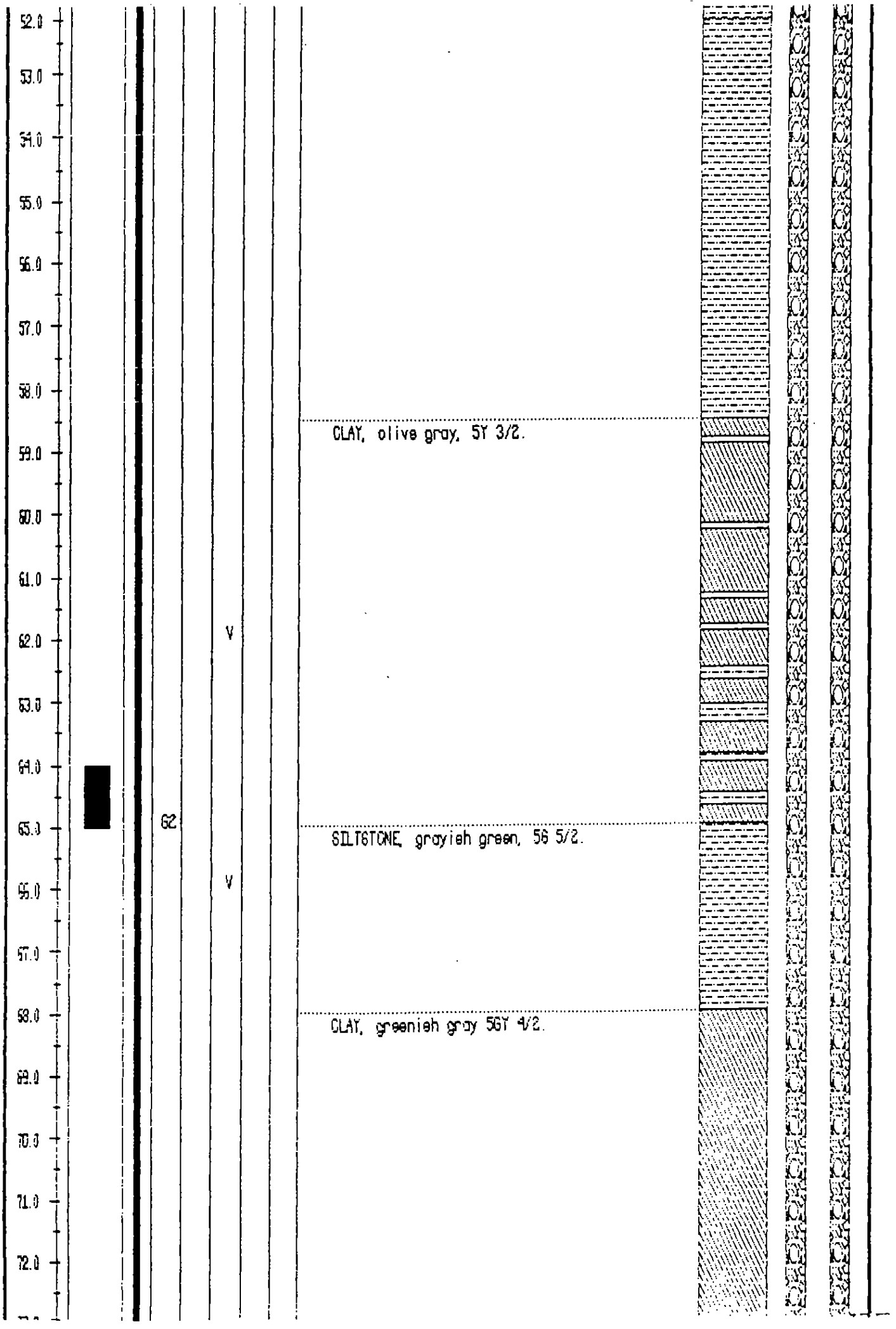
FIELD BOOK NO.: ALP-1
TOTAL DEPTH: -160.0'
GROUND SURFACE ELEVATION: 196.8'
SHEET: OF:

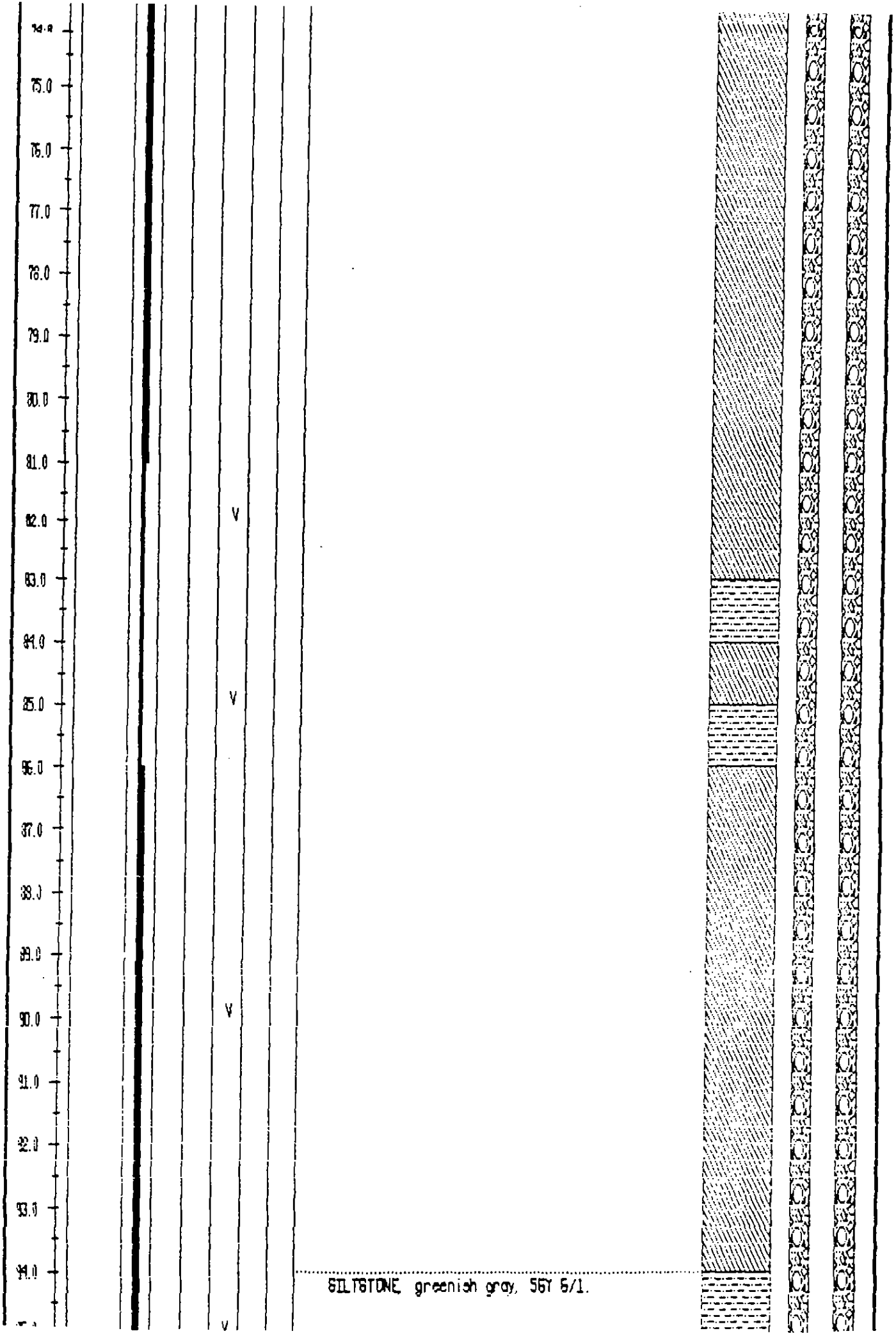
STATIC WATER LEVEL (SLS)		
WD-While Drilling AB-After Boring		
Depth(ft)	-104.12 AB	-104.26 AB
Time	0723	0737
Date:	07/19/93	07/20/93

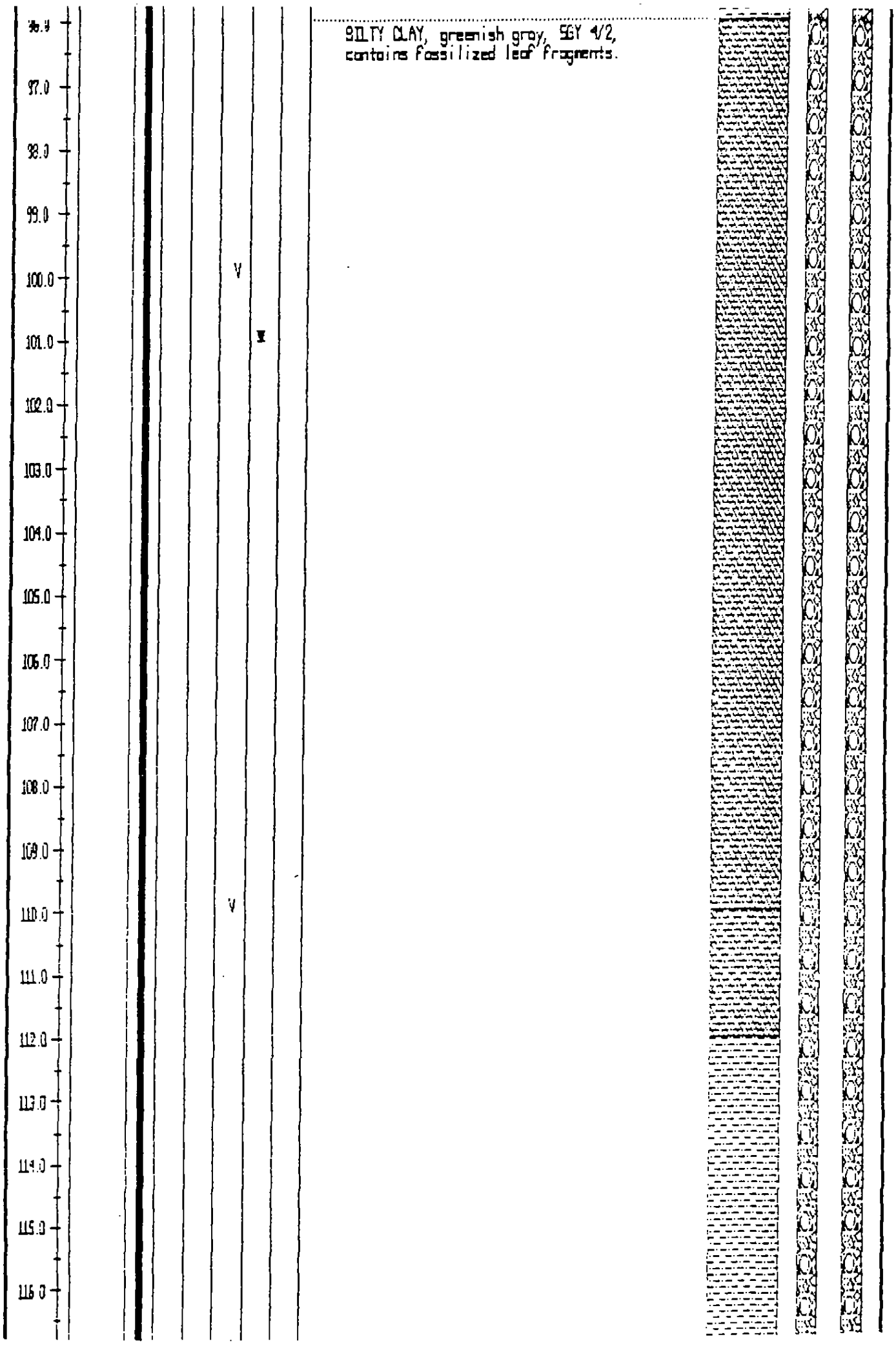
DEPTH	SOIL SAMPLES	SAMPLE RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVA * 100PPM	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
3.0										
2.0										
1.0										
0.0								TOP SOIL AND CLAY, with trace of silt: gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
1.0										
2.0					S			SAND, very silty, pale yellowish brown 10YR 6/2, very fine.		
3.0								SILTY SANDY CLAY, pale yellowish brown, 10 YR 6/		
4.0								SANDSTONE, greyish yellow green, 5GY 7/2, with horizontal iron stains		
5.0			S1		V					
6.0										
7.0			S2							

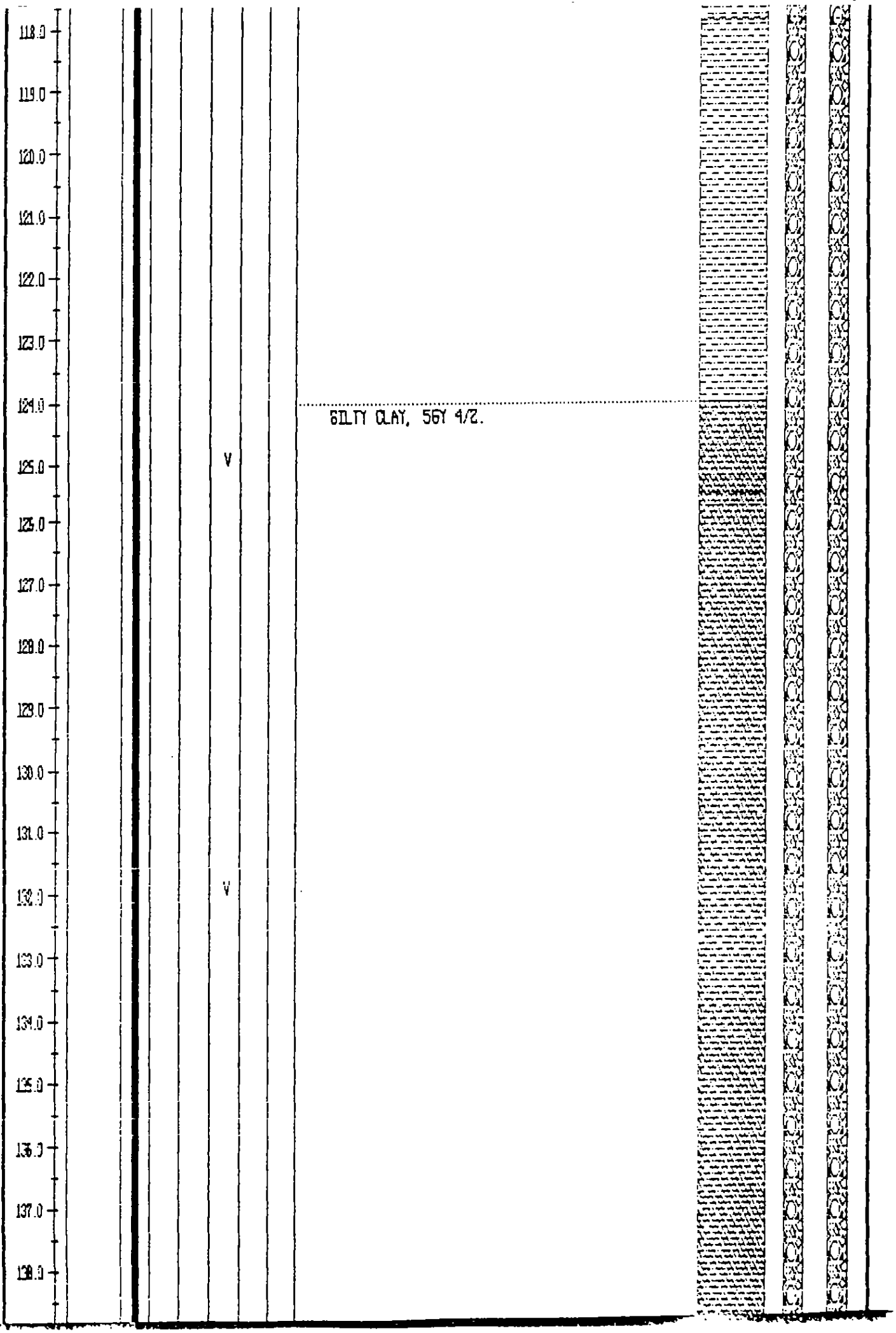

9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
D
V
V
V
SILTY CLAY, light olive gray, 5Y 6/1, highly fractured .
SANDSTONE, grayish yellow green 5GY 7/2, with iron stains, highly fractured.
CLAY, light bluish gray, 5B 7/2.

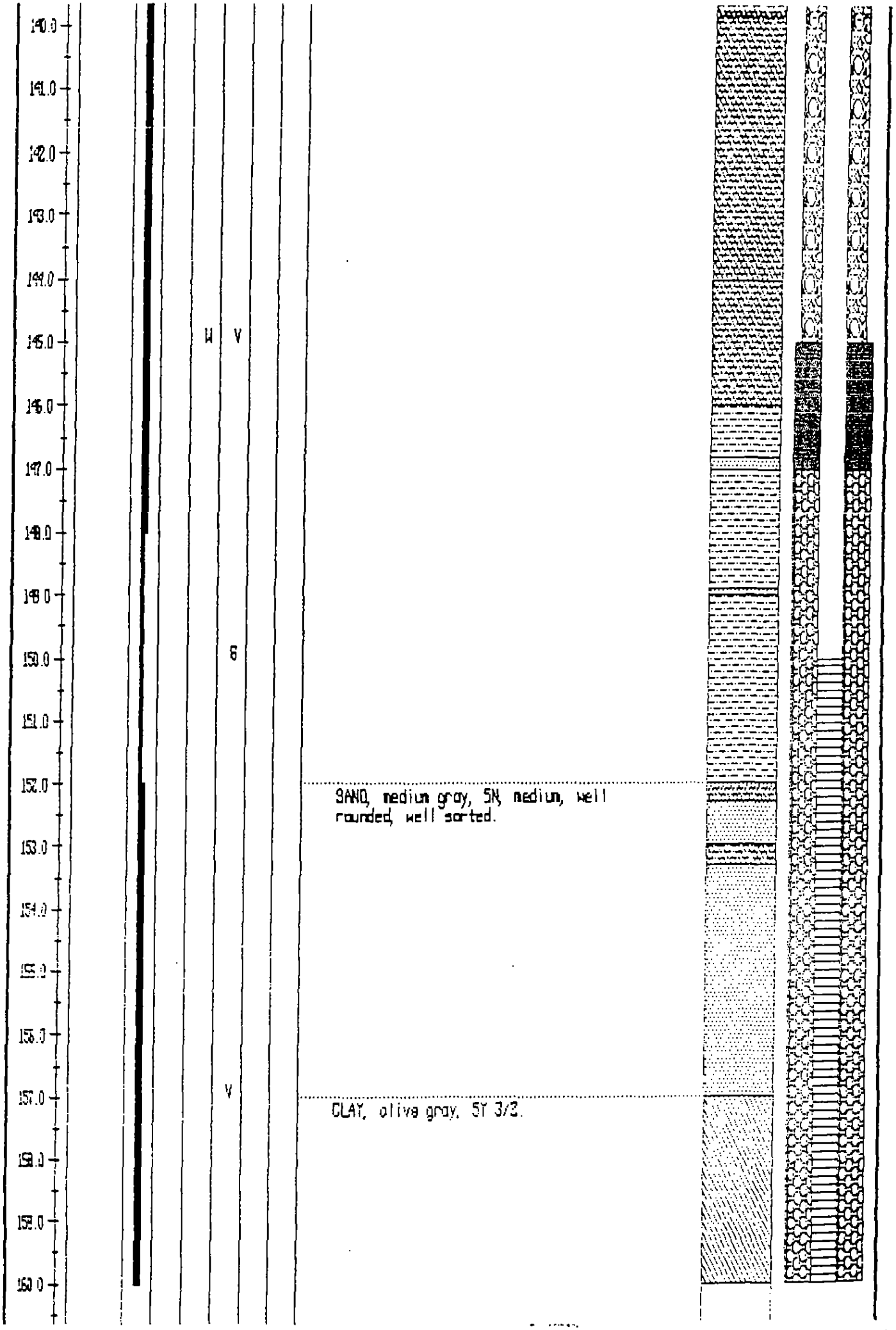

MA DEPARTMENT
CLAY, olive gray, 5Y 3/2.
SILTSTONE, greyish yellow green, 5GY 7/1.
SILTSTONE, greyish olive, 10Y 4/2,
with 1" laminations.


52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
62
CLAY, olive gray, 5Y 3/2.
SILTSTONE, grayish green, 5G 5/2.
CLAY, greenish gray 5GY 4/2.


75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
SILTSTONE, greenish gray, 5GY 6/1.


SILTY CLAY, greenish gray, 5GY 4/2,
contains fossilized leaf fragments.
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
116.0


118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
130.0
131.0
132.0
133.0
134.0
135.0
136.0
137.0
138.0
SILTY CLAY, 5GY 4/2.


140.0
141.0
142.0
143.0
144.0
145.0
146.0
147.0
148.0
149.0
150.0
151.0
152.0
153.0
154.0
155.0
156.0
157.0
158.0
159.0
160.0
SAND, medium gray, 5N, medium, well rounded, well sorted.
CLAY, olive gray, 5Y 3/3.

VIROGROUP WELL LOG

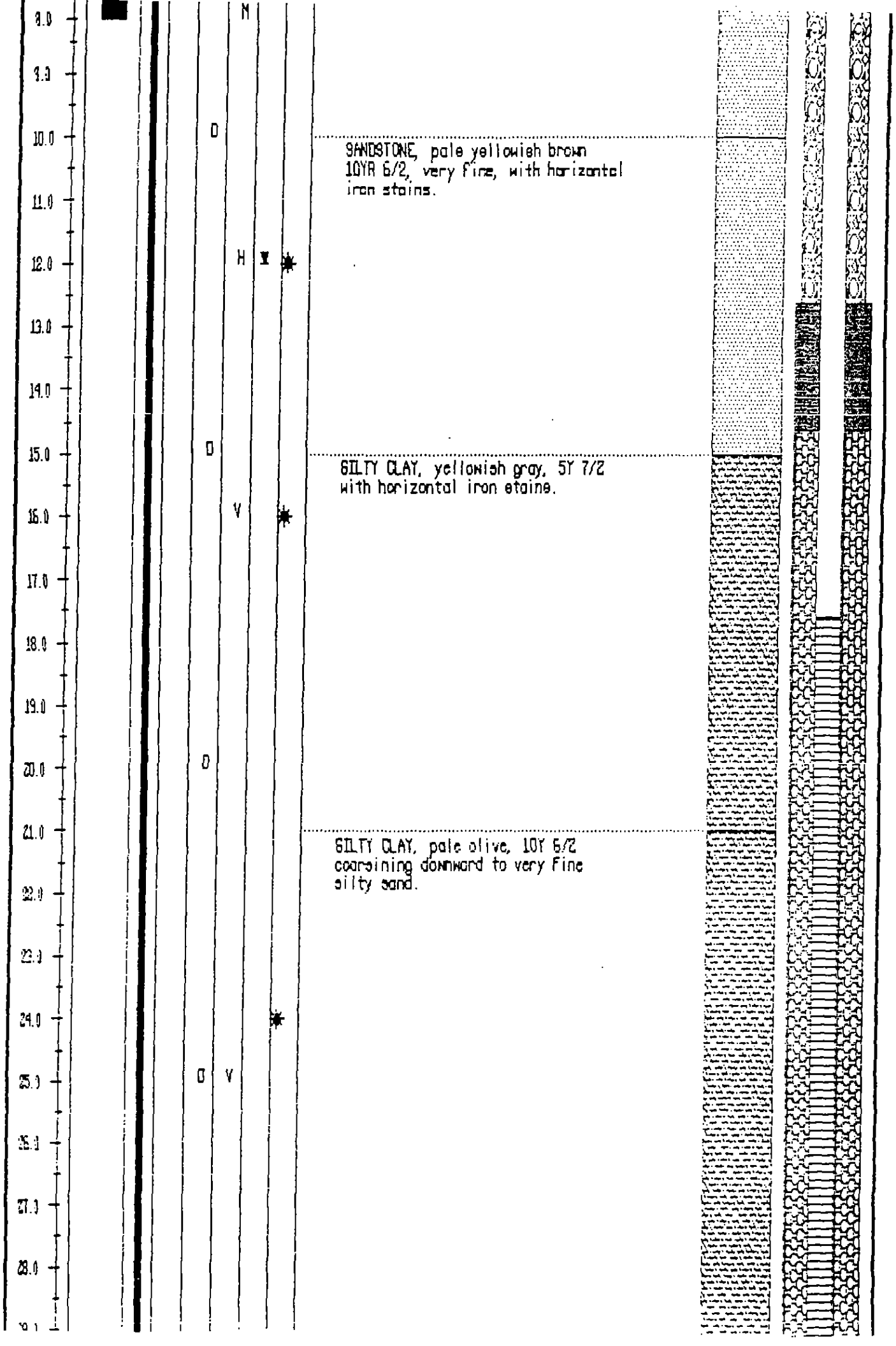
WELL NUMBER: P-3

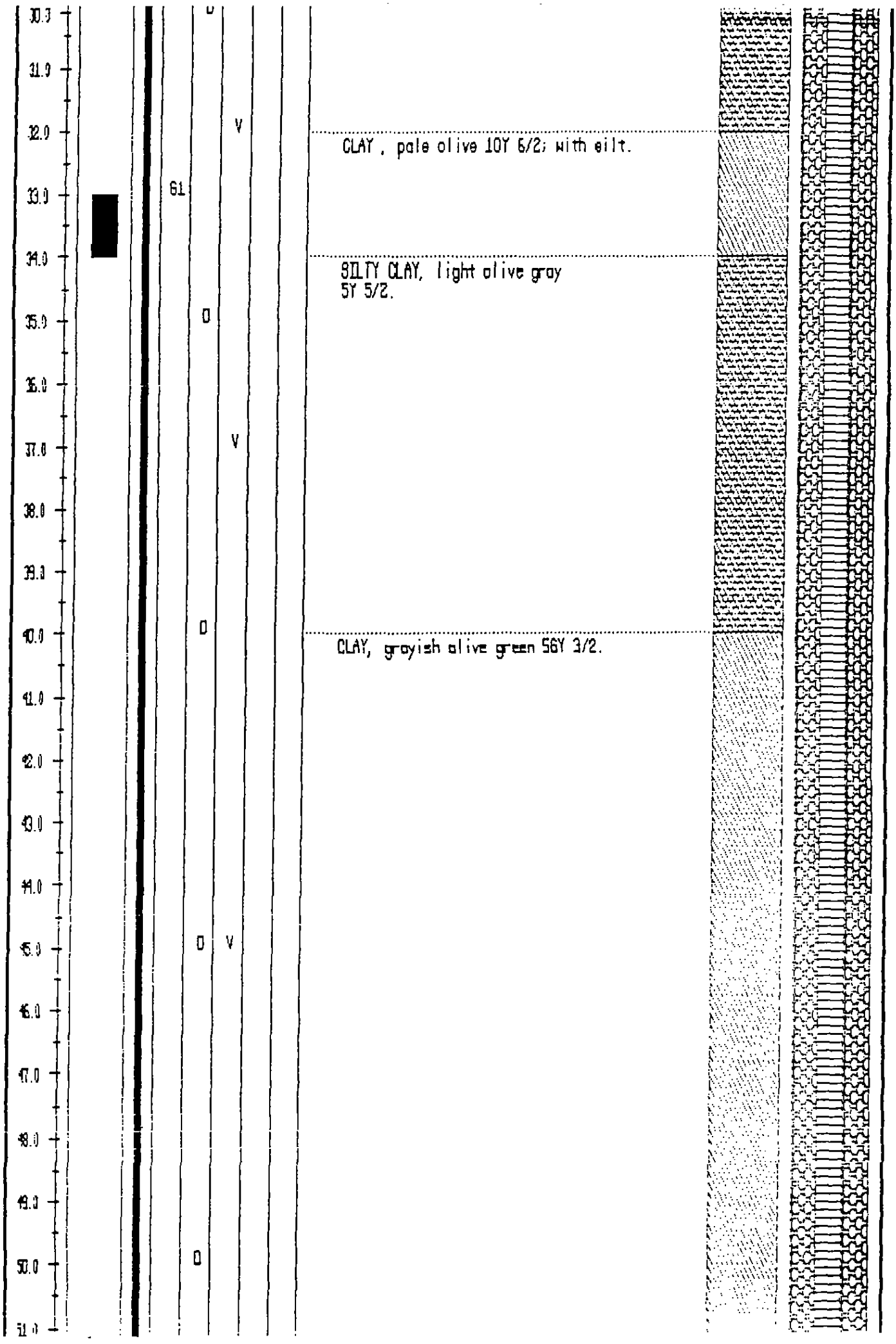
PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: 859
DRILLING METHOD: HOLLOW STEM
WEATHER: SUNNY, 95F+
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 6/2/93 DATE COMPLETED: 7/15/93

FIELD BOOK NO.: ALP-1
TOTAL DEPTH: 53.0
GROUND SURFACE ELEVATION: 163.9'
SHEET: OF:

STATIC WATER LEVEL (SLS)		
	WD-While Drilling	AB-After Boring
Depth(Ft)	0.0 AB	12.6 AB
Time	1200	0715
Date:	06/3/93	06/15/93

DEPTH	SOIL SAMPLES	SAMPLE RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVA * 100PPM	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
0.0				D				TOP SOIL AND CLAY, with trace of silt: gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
3.0			31		9			CLAY, with trace silt, 5YR 5/2.		
4.0								SANDSTONE, very silty, pale yellowish brown 10YR 6/2 very fine.		
5.0				D			*			
7.0										


8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
N
D
H
D
V
D
D
V
SANDSTONE, pale yellowish brown 10YR 6/2, very fine, with horizontal iron stains.
SILTY CLAY, yellowish gray, 5Y 7/2 with horizontal iron stains.
SILTY CLAY, pale olive, 10Y 6/2 coarsining downward to very fine silty sand.


CLAY , pale olive 10Y 6/2; with silt.
SILTY CLAY, light olive gray 5Y 5/2.
CLAY, grayish olive green 5GY 3/2.

52.0
53.0
54.0

VIROGROUP WELL LOG

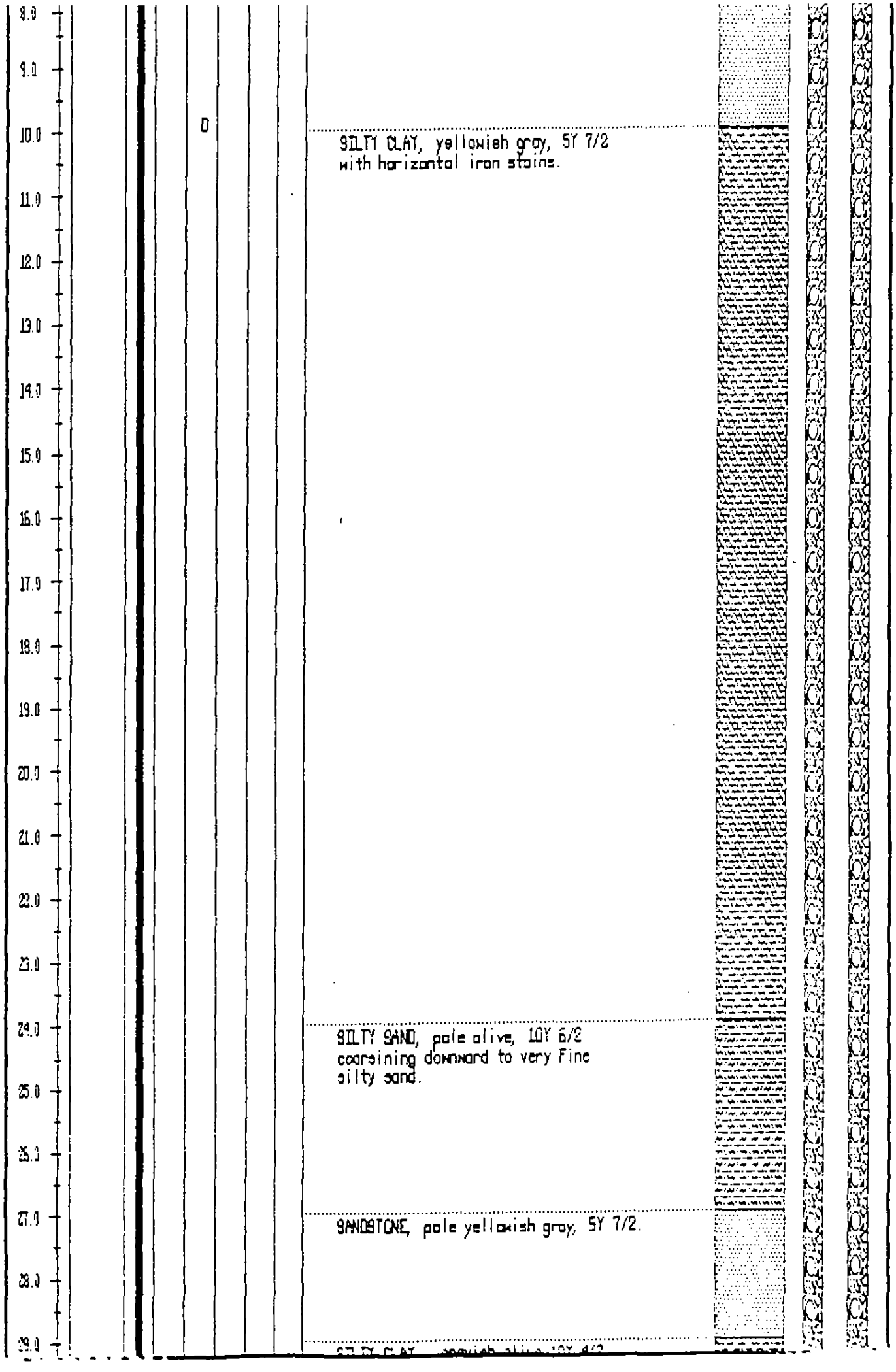
WELL NUMBER: MW-1

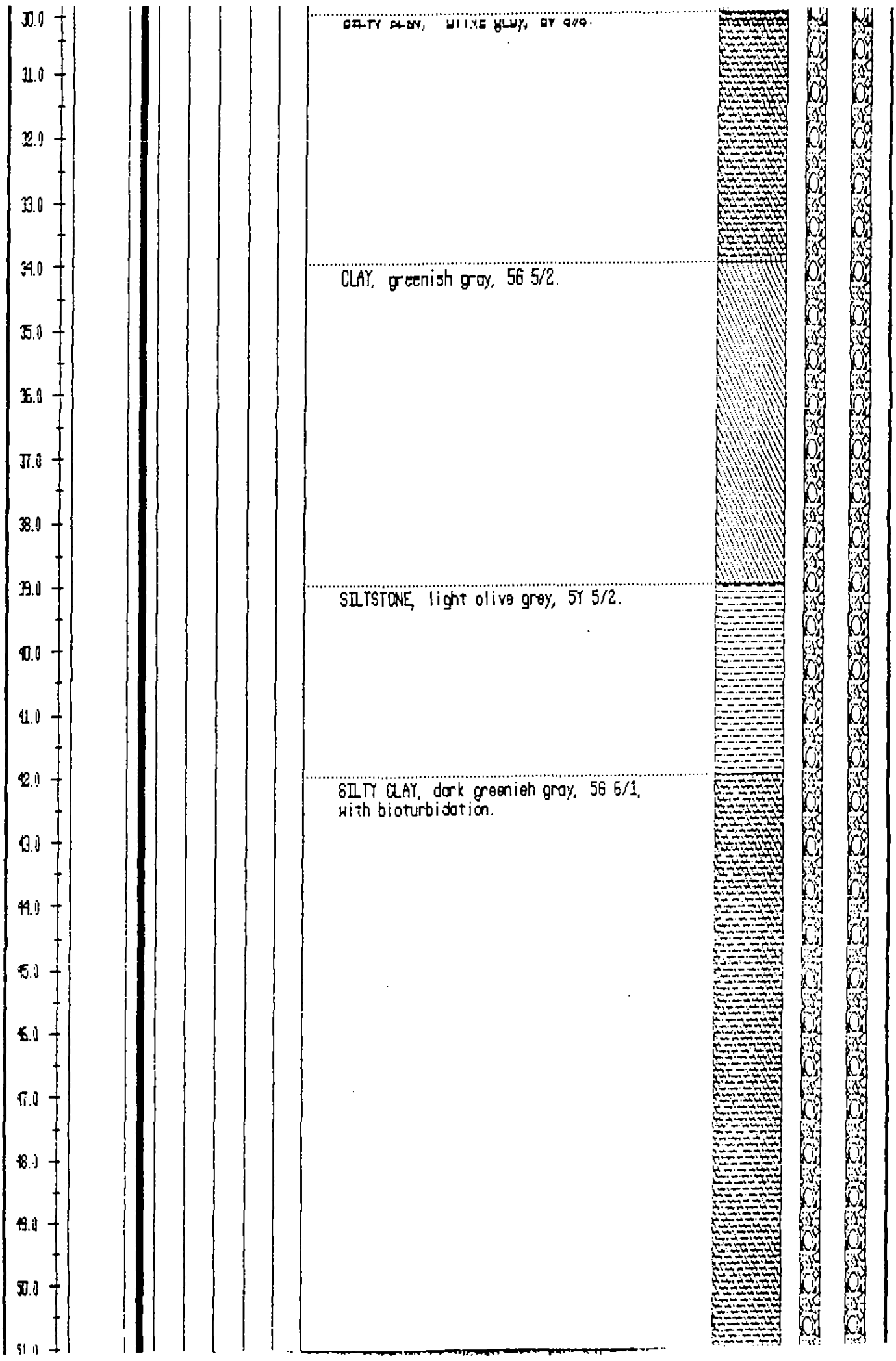
PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: B59
DRILLING METHOD: HOLLOW STEM\MUD ROTARY
WEATHER: SUNNY
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 6/9/93 DATE COMPLETED: 7/23/93

FIELD BOOK NO.: ALP-1
TOTAL DEPTH: -136.0'
GROUND SURFACE ELEVATION: 159.9'
SHEET: OF:

STATIC WATER LEVEL (BLS)		
WD-While Drilling AB-After Boring		
Depth(ft)	-75.39 AB	-75.42 AB
Time	0700	0715
Date:	07/12/93	07/13/93

DEPTH	SOIL SAMPLES	SAMPLE RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVA * 100PPM	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
3.0										
2.0										
1.0										
0.0								TOP SOIL AND CLAY, with trace of silt; gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
1.0										
2.0					V			SANDSTONE, very silty, pale yellowish brown 10YR 6/2, very fine.		
3.0								SANDSTONE, pale yellowish brown 10YR 6/2, very fine, with horizontal iron stains.		
4.0										
5.0			A1				*			
6.0										
7.0										


8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
D
SILTY CLAY, yellowish gray, 5Y 7/2
with horizontal iron stains.
SILTY SAND, pale olive, 10Y 6/2
coarsining downward to very fine
silty sand.
SANDSTONE, pale yellowish gray, 5Y 7/2.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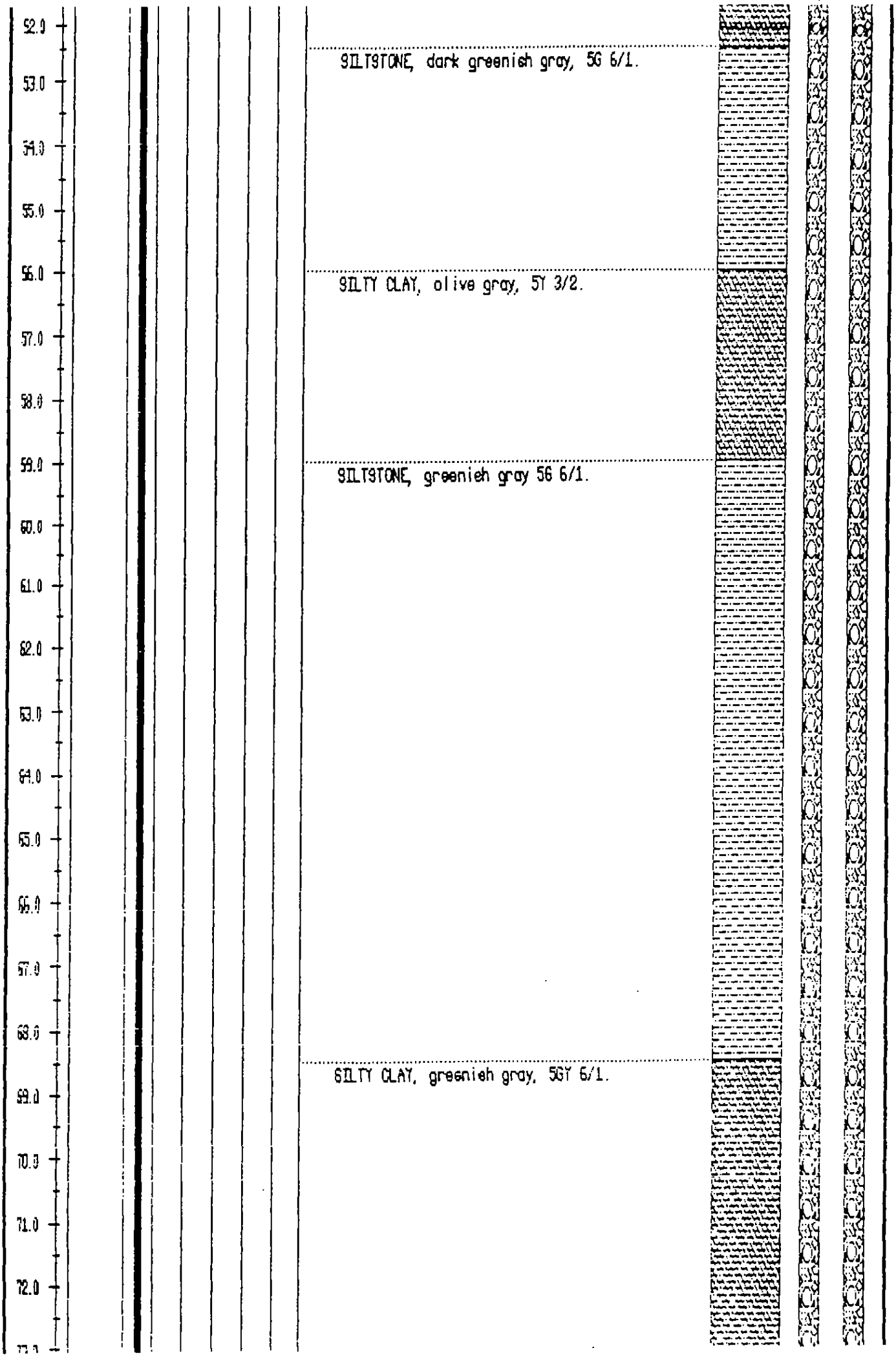
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
SILTY CLAY, olive gray, 5Y 5/2.
CLAY, greenish gray, 5G 5/2.
SILTSTONE, light olive grey, 5Y 5/2.
SILTY CLAY, dark greenish gray, 5G 6/1,
with bioturbidation.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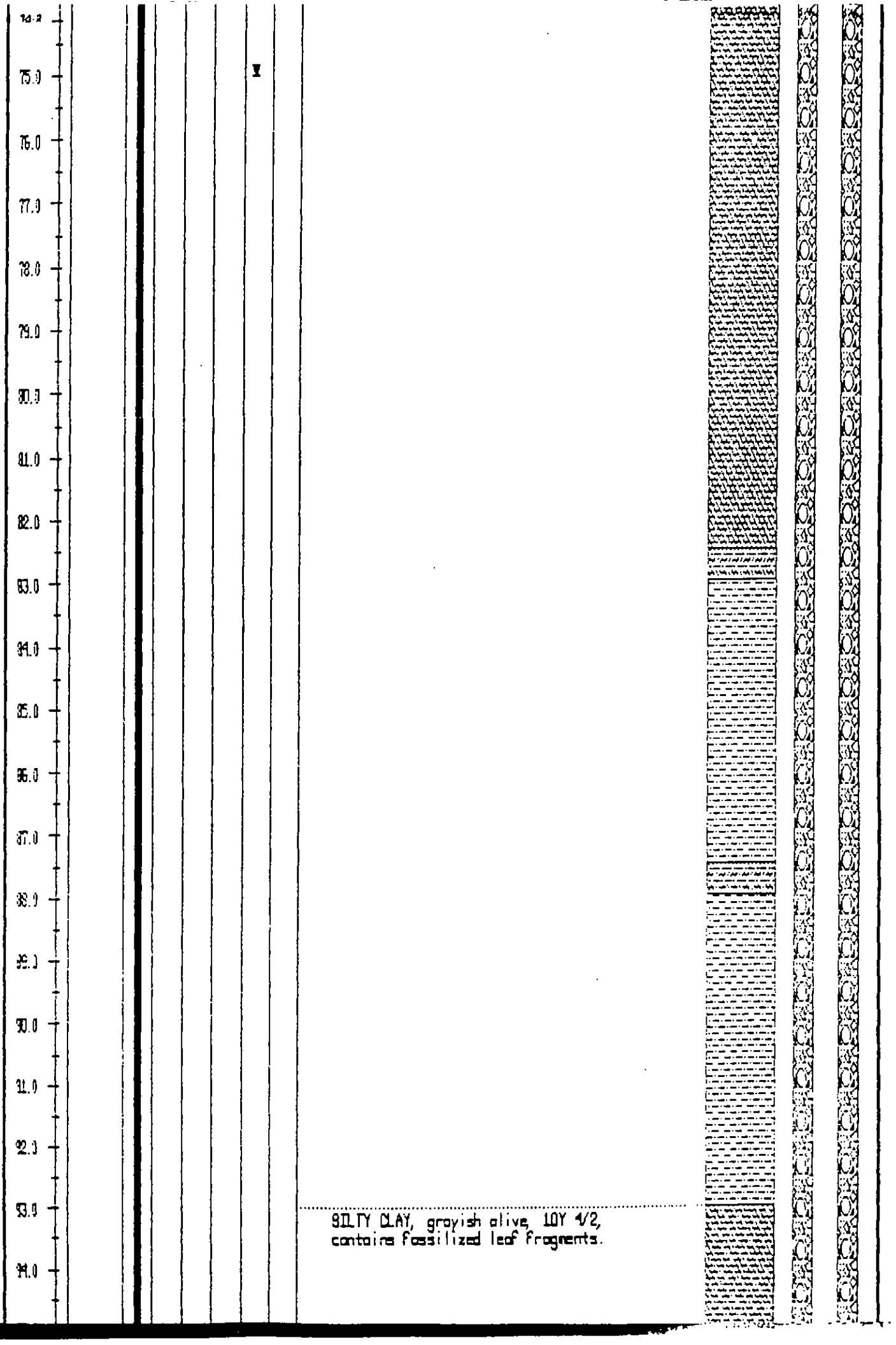
57.0
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
SILTSTONE, dark greenish gray, 5G 6/1.
SILTY CLAY, olive gray, 5Y 3/2.
SILTSTONE, greenish gray 5G 6/1.
SILTY CLAY, greenish gray, 5GY 6/1.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77.0
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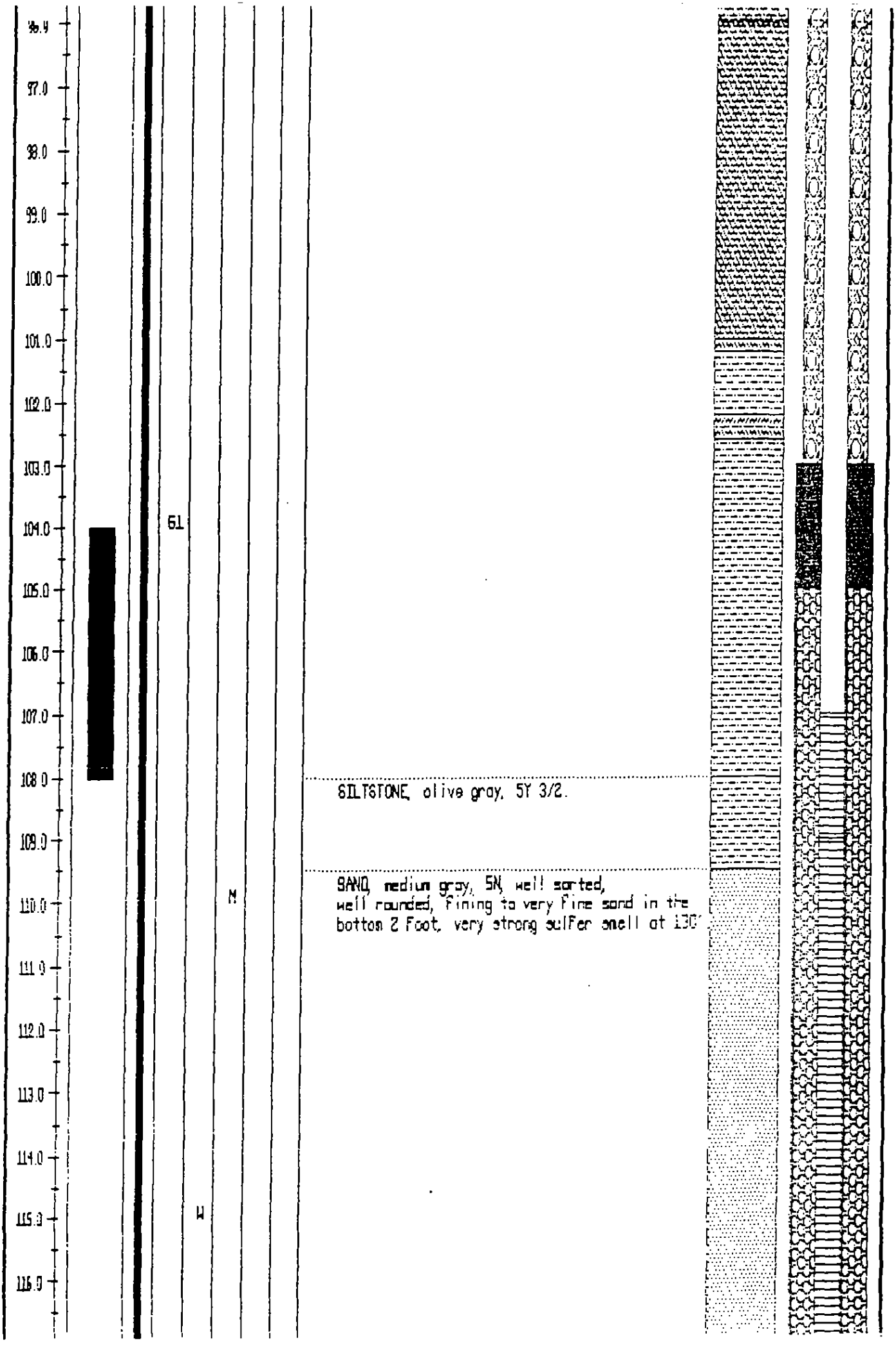
79.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
90.0
91.0
92.0
93.0
94.0
SILTY CLAY, grayish olive, 10Y 4/2,
contains fossilized leaf fragments.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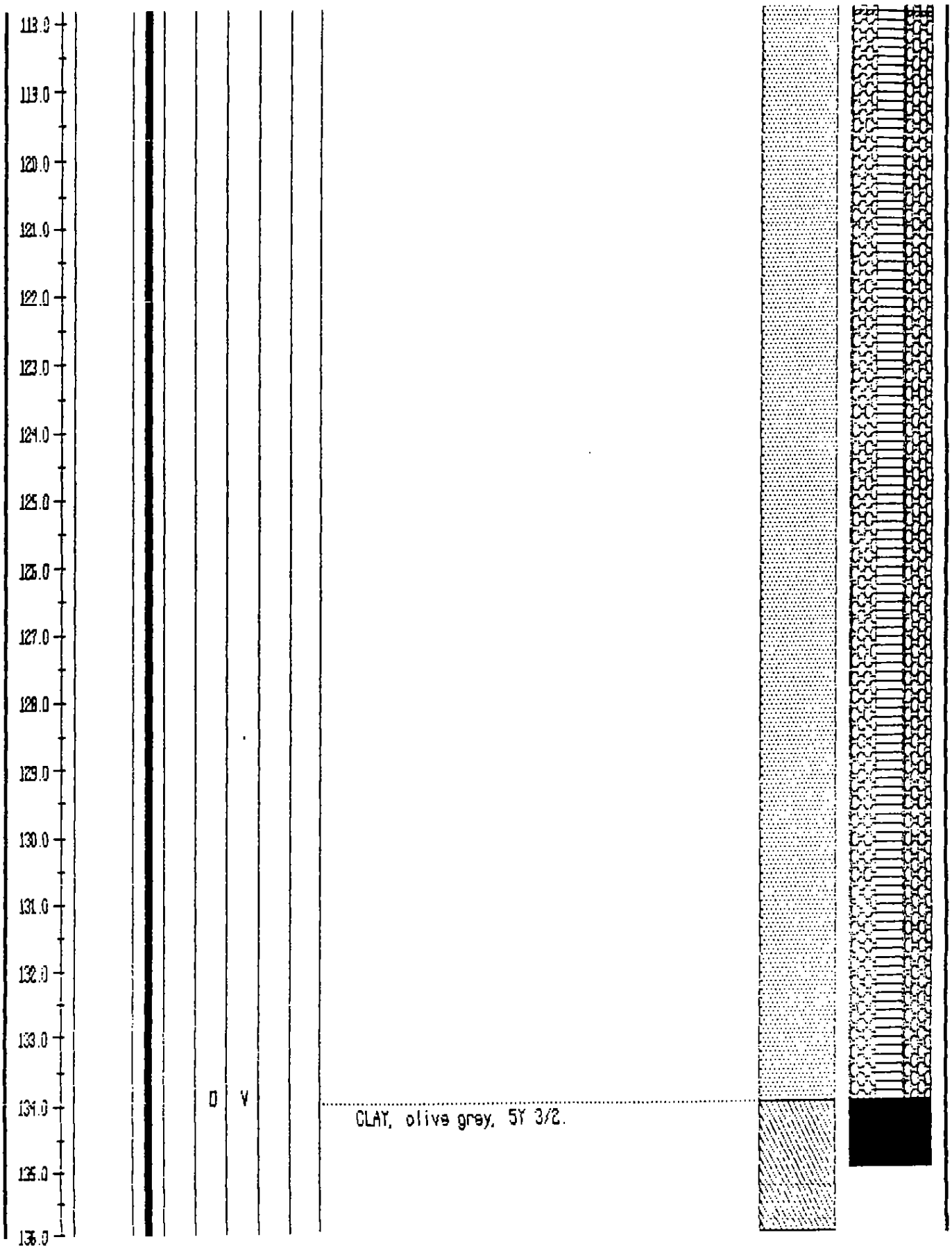
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
116.0
61
M
M
SILTSTONE, olive gray, 5Y 3/2.
SAND, medium gray, 5N, well sorted,
well rounded, fining to very fine sand in the
bottom 2 Foot, very strong sulfer smell at 130'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118.0
120.0
121.0
122.0
123.0
124.0
125.0
126.0
127.0
128.0
129.0
130.0
131.0
132.0
133.0
134.0
135.0
136.0
D
V
CLAY, olive grey, 5Y 3/2.

VIROGROUP WELL LOG

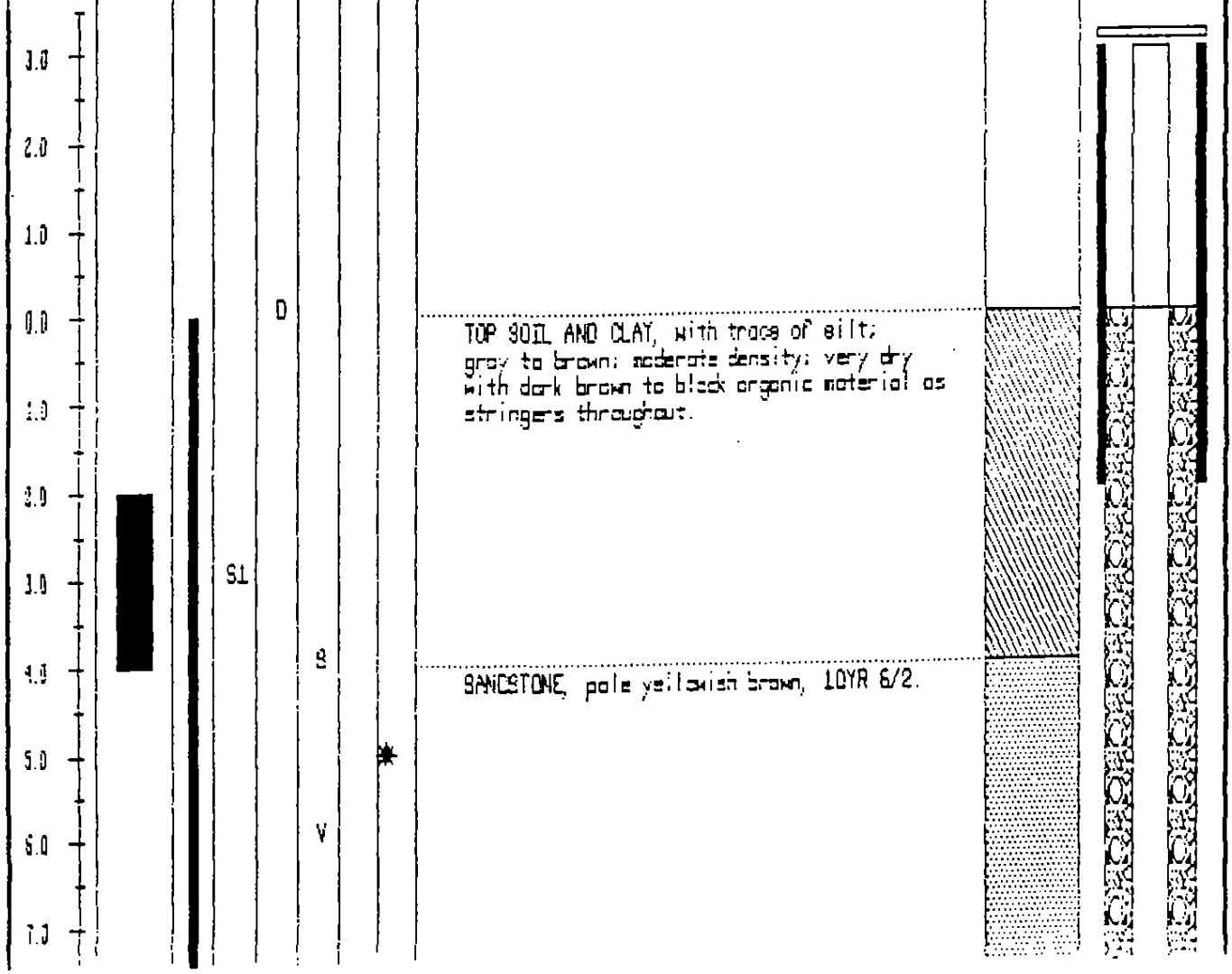
WELL NUMBER: MW2

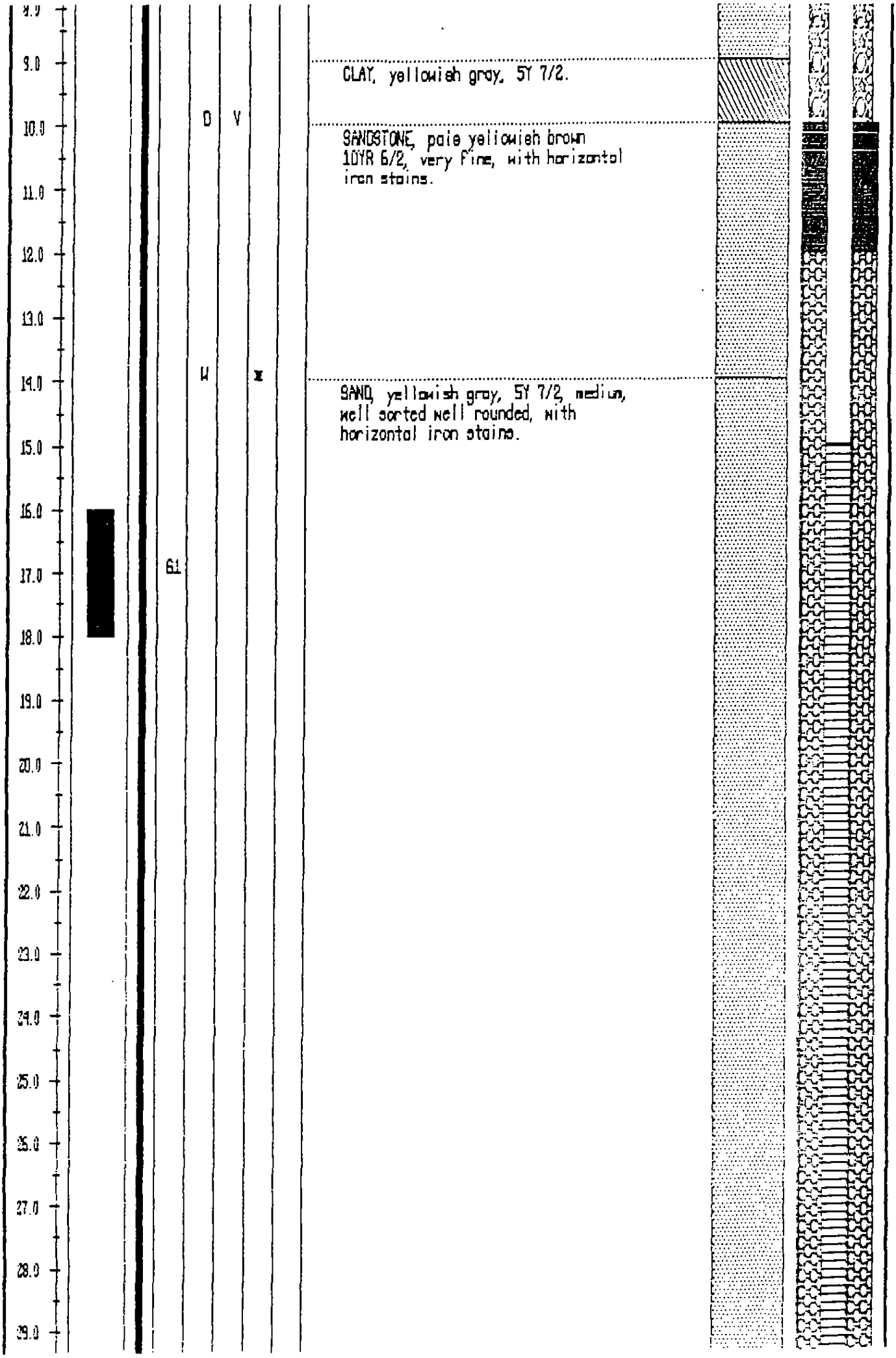
PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: B59
DRILLING METHOD: HOLLOW STEM
WEATHER: SUNNY 95F+
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 7/13/93 DATE COMPLETED: 7/23/93

FIELD BOOK NO.: ALP-1
TOTAL DEPTH: 40.0
GROUND SURFACE ELEVATION: 163.2'
SHEET: OF:

STATIC WATER LEVEL (BLS)		
WD-While Drilling AB-After Boring.		
Depth(ft)	-21.8 BGS	-14.76 BGS
Time	0805	0812
Date:	07/20/93	07/22/93

DEPTH | SOIL SAMPLES | SAMPLE RECOVERY | SAMPLE NUMBER | MOISTURE | DENSITY | WATER LEVEL | OVA * 100PPM | LOCATION DIAGRAM | LITHOLOGY | WELL INSTALLATION




8.0
9.0
10.0
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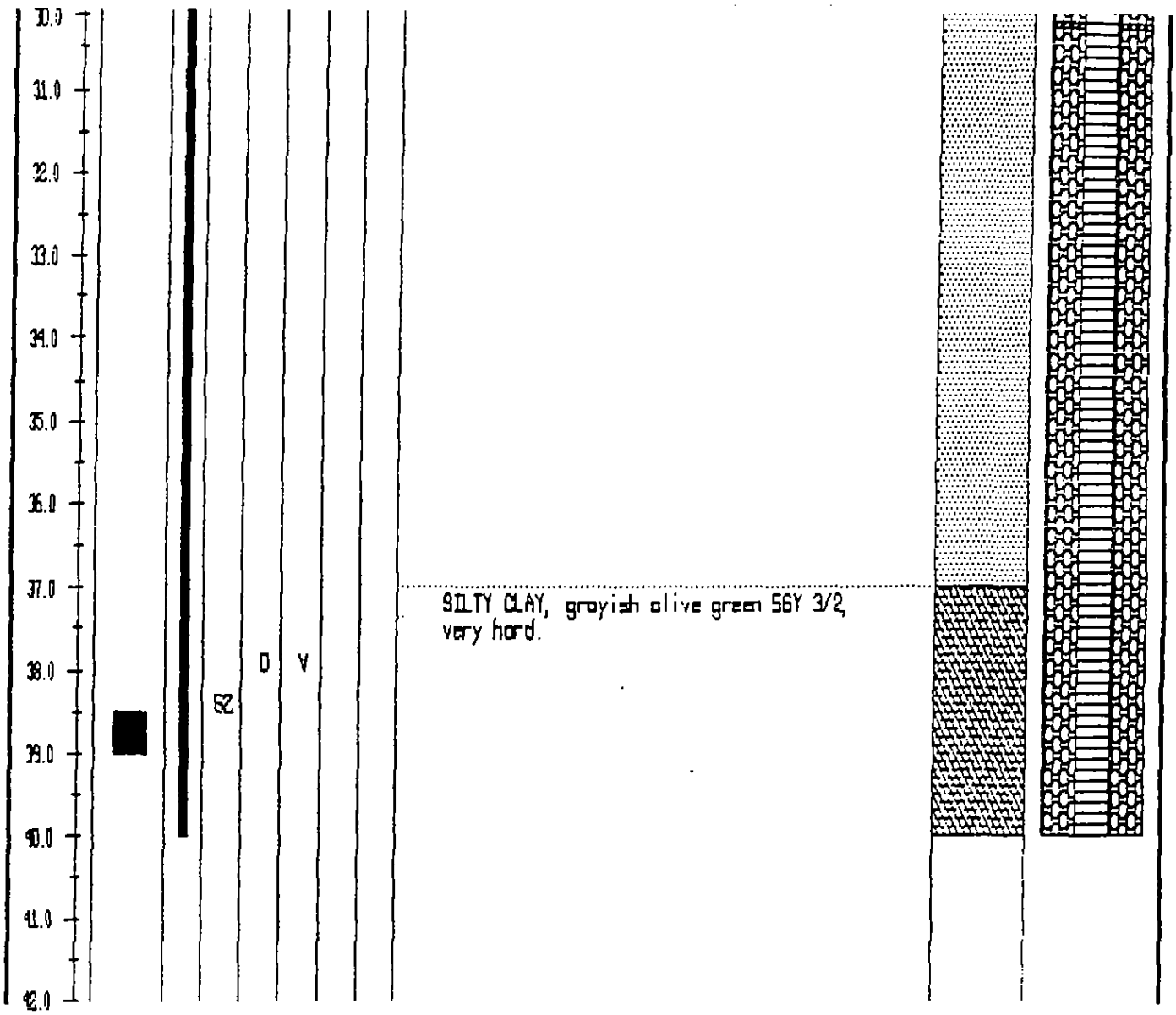
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
D
V
W
X
61
CLAY, yellowish gray, 5Y 7/2.
SANDSTONE, pale yellowish brown 10YR 6/2, very fine, with horizontal iron stains.
SAND, yellowish gray, 5Y 7/2, medium, well sorted well rounded, with horizontal iron stains.


10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
SILTY CLAY, grayish olive green 5GY 3/2, very hard.

VIROGROUP WELL LOG

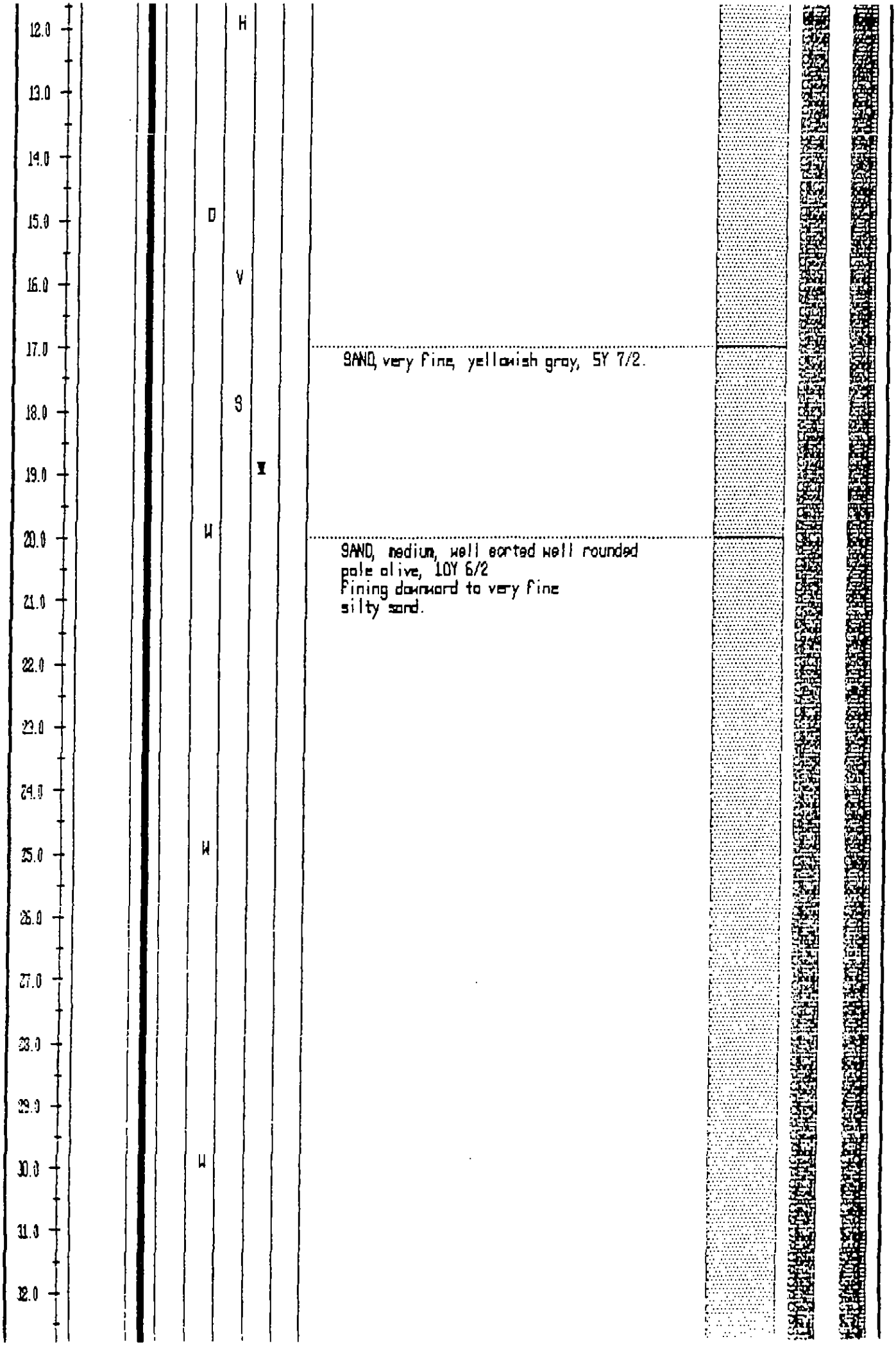
WELL NUMBER: SB-1

PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: GROUNDWATER PROTECTION
RIG TYPE & NUMBER: 859
DRILLING METHOD: HOLLOW STEM
WEATHER: SUNNY
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 5/14/93 DATE COMPLETED: 5/14/93

FIELD BOOK NO.: ALP-1
TOTAL DEPTH: 52.0
GROUND SURFACE ELEVATION: 169.9'
SHEET: OF:

STATIC WATER LEVEL (BLS)		
	WD-While Drilling	AB-After Boring
Depth(Ft)	-20.0 BGS	-19.6 BGS
Time	1439	1506
Date:	05/14/93	05/14/93

DEPTH	SOIL SAMPLES	SAMPLE RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVA * 100PPM	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
0.0				D				TOP SOIL AND CLAY, with trace of silt; gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
1.0										
2.0								CLAY, with trace silt, 5YR 5/2.		
3.0										
4.0					S					
5.0				D						
6.0					V			CLAY SILT SAND, very silty, pale yellowish brown 10YR 6/2, very fine.		
7.0										
8.0								SANDSTONE, pale yellowish brown 10YR 6/2, very fine, with horizontal iron stains.		
9.0										
10.0				D						


12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
H
D
V
S
W
W
W
SAND, very fine, yellowish gray, 5Y 7/2.
SAND, medium, well sorted well rounded
pale olive, 10Y 6/2
Fining downward to very fine
silty sand.

34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0

W
W
W
V
D

SAND, very fine, poorly sorted, pale olive 10Y 6/2; with silt.

SILTY CLAY, grayish olive green 5GY 3/2, very hard.

VIROGROUP BOREHOLE LOG

PROJECT NUMBER: 07-02011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: LAYNE ENVIRONMENTAL
RIG TYPE & NUMBER: 999
DRILLING METHOD: HOLLOW STEM
WEATHER: CLOUDY, 30
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 12/22/93 DATE COMPLETED: 12/28/93

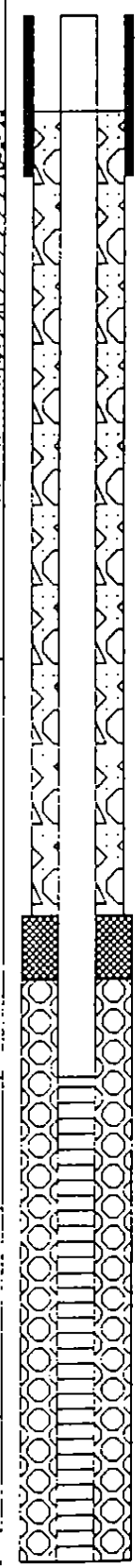
FIELD BOOK NO.: ALP-1 Borehole Number: P-4
TOTAL DEPTH: -46.0
GROUND SURFACE ELEVATION: 169.8'
SHEET: OF:

STATIC WATER LEVEL (BLS)		
HD-White Drilling		AB-After Boring
Depth(FT)	-17.23.0 BGS	-17.05 BGS
Time	1434	1806
Date:	12/22/93	12/23/93

DEPTH	SOIL SAMPLES	SAMPLING RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	OVM=100ppm	LOCATION DIAGRAM
0.0				D				TOP SOIL AND CLAY, with trace of silt; gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.
2.0								CLAY, with trace silt, 5YR 5/2.
5.0				D				
6.0								CLAY SILT SAND, very silty, pale yellowish brown 10YR 6/2, very fine.
8.0								SANDSTONE, pale yellowish brown 10YR 6/2, very fine, with horizontal iron stains.
10.0				D				
15.0				D				
16.0						▼		
17.0								SILTY CLAY, pale yellow brown 10YR 6/2.
20.0				E				
25.0				E				
30.0				E				SAND, very fine, yellowish gray, 5Y 7/2.
34.0								SAND, medium, well sorted well rounded pale olive, 10Y 6/2 Fining downward to very fine silty sand.
39.0				E				
40.0				E				
41.0								SAND, very fine, poorly sorted, pale olive 10Y 6/2, with silt
44.0								SILTY CLAY, grayish olive green 5GY 3/2 very hard
45.0				E				

LITHOLOGY

WELL INSTALLATION



VIROGROUP BOREHOLE LOG

PROJECT NUMBER: 07-08011.01
PROJECT NAME: PRELIMINARY GEOLOGIC INVESTIGATION
LOCATION: COLFAX, LOUISIANA
DRILLING COMPANY: LAYNE ENVIRONMENTAL
RIG TYPE & NUMBER: 999
DRILLING METHOD: HOLLOW STEM
WEATHER: CLOUDY, TEMP. 30
FIELD PARTY: ALAN L. PIECHOCKI
GEOLOGIST: ALAN L. PIECHOCKI
DATE BEGUN: 12/21/92 DATE COMPLETED: 12/28/92

FIELD BOOK NO.: ALP-8
TOTAL DEPTH: -50.0'
GROUND SURFACE ELEVATION: 184.0'
SHEET: OF:

Borehole Number: P-5

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AS=After Spring	
Depth(ft)	-38.78 AS	-34.38 AS
Time	0716	0784
Date	12/22/92	12/23/92

DEPTH	SOIL SAMPLES	SAMPLING RECOVERY	SAMPLE NUMBER	MOISTURE	DENSITY	WATER LEVEL	CHAN+CO2 ppm	LOCATION DIAGRAM	LITHOLOGY	WELL INSTALLATION
0.0								TOP SOIL AND CLAY, with trace of silt; gray to brown; moderate density; very dry with dark brown to black organic material as stringers throughout.		
2.0								SANDSTONE, very silty, pale yellowish brown 10YR 6/2, very fine.		
4.0								SILTY CLAY, pale yellowish brown, 10 YR 6/2.		
9.0								SILTY CLAY, light olive gray, 5Y 6/1, with horizontal iron stains.		
10.0				D						
21.0								SILTY CLAY, dark greenish gray, 5G 4/1		
30.0								SANDSTONE, pale yellowish gray, 5Y 7/2 with iron stains.		
33.0						▼				
35.0				W				SAND, pale yellowish gray, 5Y 7/2 medium, well rounded, well sorted with horizontal iron stains.		
50.0				D				CLAY, grayish olive, 10Y 4/2		

APPENDIX 2-C
GEOTECHNICAL ANALYSES

OFFICE PHONES:
318 443-7429
318 442-9879
FAX: 318 443-1305

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

August 16, 1993

File No.: 11393

3rd Report

Description: Permeability of Soils

Project : R. & D. Facility, Colfax, Louisiana

Reported To: Viro Group, Inc., 245 Antibes West, Mandeville, La.
Attention: Mr. Alan Piechocki

Dear Mr. Piechocki,

Below are our results of the remaining two soil samples which were obtained by your firm from the above subject project, and delivered to our laboratory for analysis.

Method of Tests: ASTM D1140, D4318, D2438-68

Sample I.D.	P-2, 16'-18'	P-3, 4' 5'
Soil Description :	Brownish and Blue Gray Clay	Gray Sandy Clay
In Situ Moisture, % :	40.7	17.3
Dry Unit Weight, pcf :	77.3	108.0
Liquid Limit (LL) :	100	43
Plasticity Index (PI) :	31	28
Percent Finer Than No. 200:	94.8	50.5
ASTM Classification :	CH	CL
Permeability, cm./sec. :	1.4×10^{-5}	3.6×10^{-5}

In accordance with your verbal request, we will be shipping the leftover portions of soil from each sample via U.P.S.

It was a pleasure performing these services for you. If we can be of further assistance, please advise.

GEOTECHNICAL TESTING LABORATORY, INC.

Ken Gorsha
President

2cc: Viro Group, Inc.

KRG/kgt

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients. And authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

OFFICE PHONES:
318 443-7429
318 442-9879
FAX: 318 443-1305

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

August 3, 1993

AUG - 5 1993

File No.: 11393

1st Report

Description: Permeability of Soils

Project : R. & D. Facility, Colfax, Louisiana

Reported To: Viro Group, Inc., 245 Antibes West, Mandeville, La.
Attention: Mr. Alan Piechocki

Dear Mr. Piechocki,

Below are our results on two soil samples which were obtained from the above subject project and delivered to our laboratory for analysis.

Method of Tests: ASTM D1140, D4318, D2438-68

Sample I.D.	M.W. 2, 9' - 10'	M.W. 2, 39'
Soil Description :	Gray Clay w/traces of sand	Gray Clay w/sand seams and pockets
In Situ Moisture, % :	37.4	17.8
Dry Unit Weight, pcf :	83.3	109.1
Liquid Limit (LL) :	73	50
Plasticity Index (PI) :	54	32
Percent Finer Than No. 200:	98.1	68.6
ASTM Classification :	CH	CH
Permeability, cm./sec. :	4.0×10^{-5}	1.1×10^{-6}

It was a pleasure performing these services for you. Please contact our office if you have any questions concerning any aspect of this report or if we can be of further assistance.

GEOTECHNICAL TESTING LABORATORY, INC.

Ken Gorsha

Ken Gorsha
President

2cc: Viro Group, Inc.

KRG/tjw

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients. And authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

OFFICE PHONES:
318 443-7429
318 442-9879
FAX: 318 443-1305

Geotechnical Testing Laboratory, Inc.

226 PARKWOOD DRIVE P. O. BOX 7734
ALEXANDRIA, LOUISIANA 71306

August 6, 1993

File No.: 11393

2nd Report

Description: Permeability of Soils

Project : R. & D. Facility, Colfax, Louisiana

Reported To: Viro Group, Inc., 245 Antibes West, Mandeville, La.
Attention: Mr. Alan Piechocki

Dear Mr. Piechocki,

Below are our results on two additional soil samples which were obtained by your firm from the above subject project.

Method of Tests: ASTM D1140, D4318, D2438-68

Sample I.D.	M.W. 1, 104'-108'	P-1, 3' 4'
Soil Description	Gray Clay w/small sand pockets	Gray Clay w/sand traces
In Situ Moisture, %	24.2	23.6
Dry Unit Weight, pcf	96.3	90.6
Liquid Limit (LL)	70	76
Plasticity Index (PI)	52	51
Percent Finer Than No. 200	93.9	94.6
ASTM Classification	CH	CH
Permeability, cm./sec.	8.6×10^{-7}	9.0×10^{-6}

It was a pleasure performing these services for you. If we can be of further assistance, please advise.

GEOTECHNICAL TESTING LABORATORY, INC.

Ken Gorsha

Ken Gorsha
President

2cc: Viro Group, Inc.

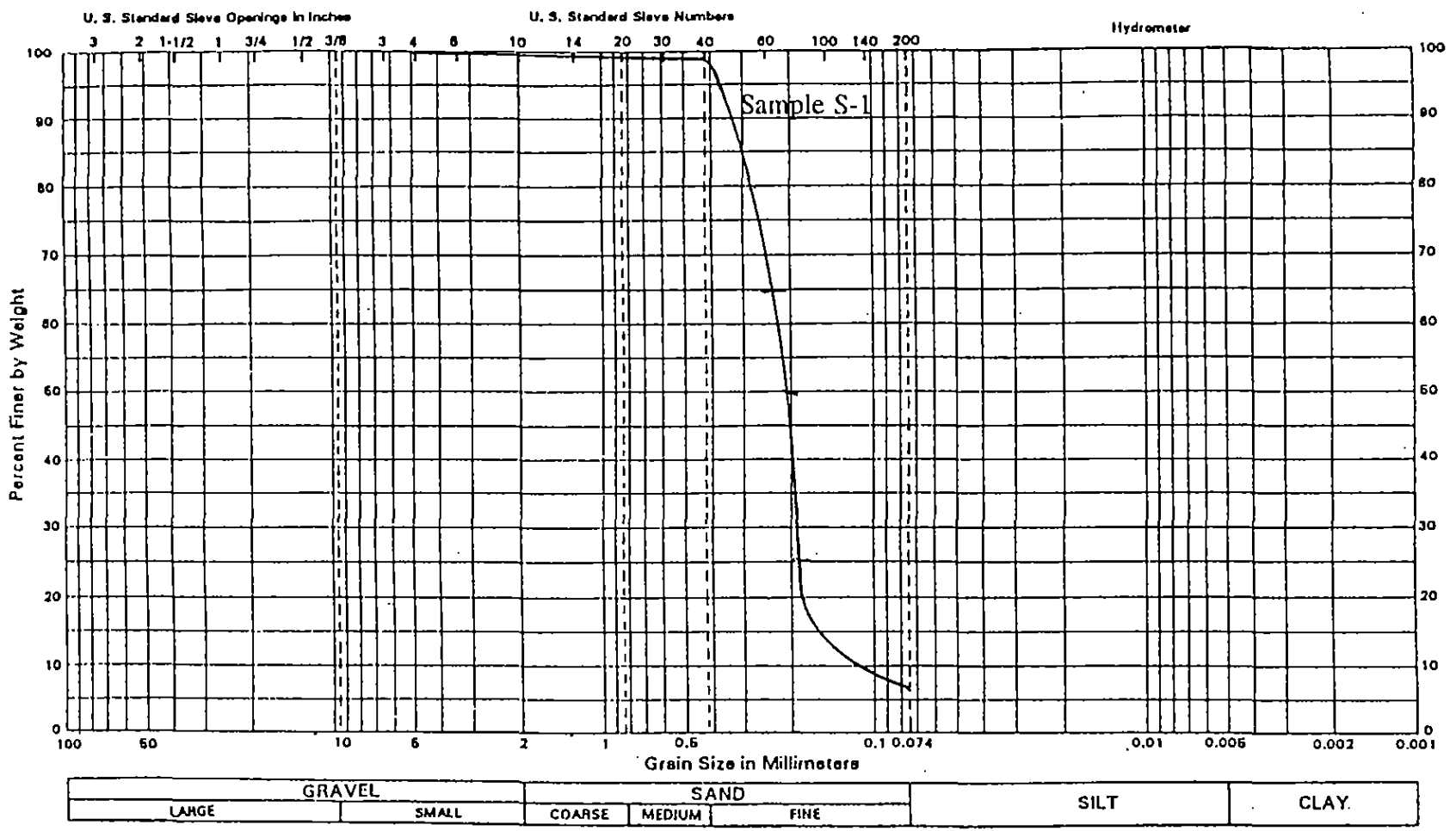
KRG/kgt

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients. And authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

APPENDIX 2-D

GEOTECHNICAL SIEVE ANALYSES

J-5353



% PASSING NO. 200 SIEVE = 7.61

GRAIN SIZE DETERMINATION

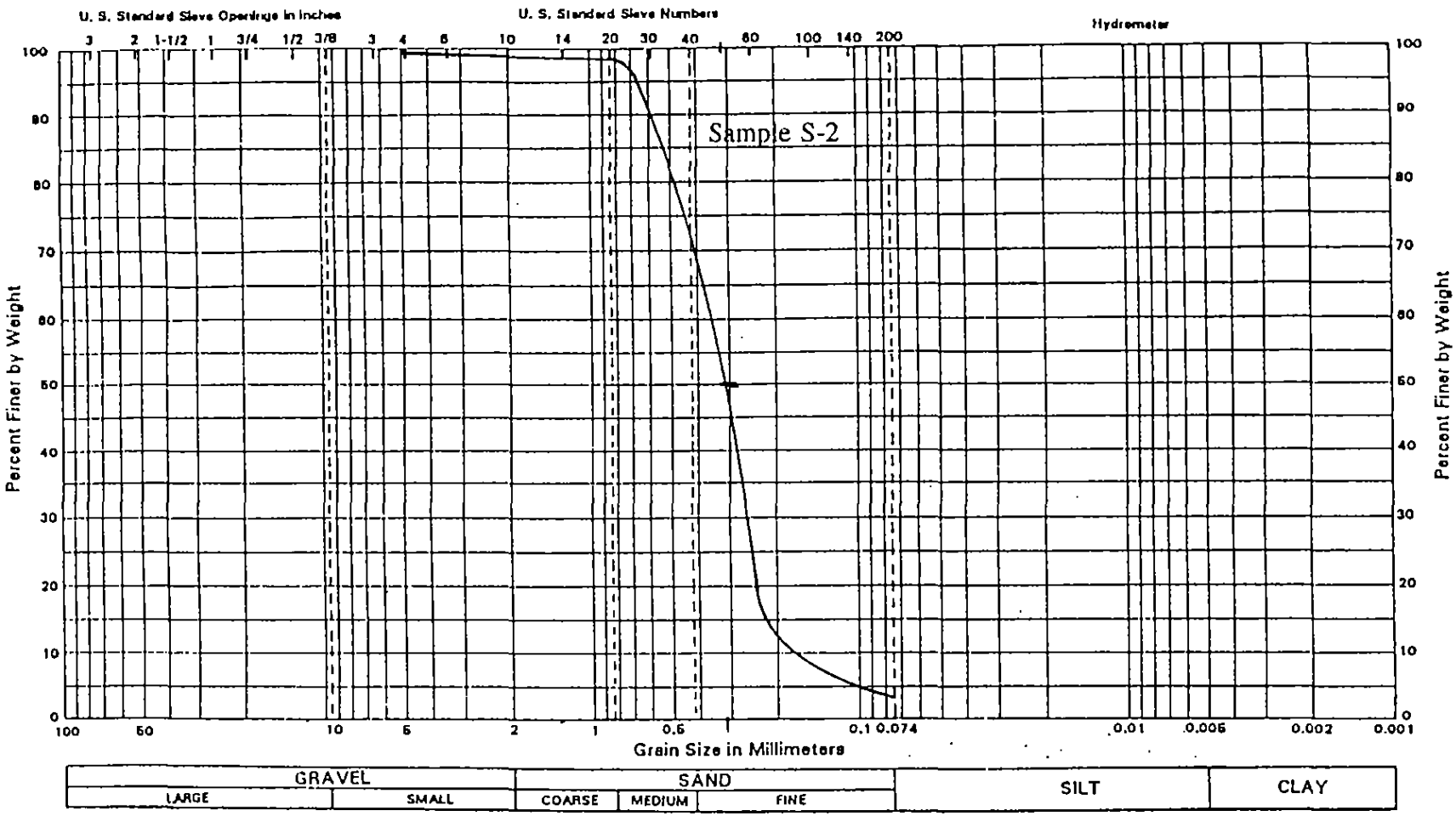
SIEVE ANALYSIS ON FURNISHED SAMPLE
R & D COLFAX PROJECT

VIRO GROUP, INC.
MANDEVILLE, LA.

Fig. 1

GORE ENGINEERING, INC.
SOIL AND FOUNDATION INVESTIGATIONS

J-5353



% PASSING NO. 200 SIEVE = 4.25

GRAIN SIZE DETERMINATION

SIEVE ANALYSIS ON FURNISHED SAMPLE
R & D COLFAX PROJECT

VIRO GROUP, INC.
MANDEVILLE, LA.

Fig. 2

GORE ENGINEERING, INC.
SOIL AND FOUNDATION INVESTIGATIONS

APPENDIX 2-E

GEOPHYSICAL BOREHOLE LOGS

FINAL REPORT

GEOPHYSICAL BOREHOLE LOGGING

COLFAX R&D FACILITY
COLFAX, LOUISIANA

Prepared For:

LAIDLAW ENVIRONMENTAL SERVICES, INC.

COLUMBIA, SOUTH CAROLINA

JULY 1993

SDII
SUBSURFACE
DETECTION
INVESTIGATIONS
INCORPORATED

July 30, 1993

Laidlaw Environmental Services, Inc.
P.O. Box 210799
Columbia, SC 29221

Attention: Mr. Sam Moore

Subject: **Final Report - Geophysical Borehole Logging**
Colfax R&D Facility, Colfax, Louisiana
SDII Project No. 93761

Dear Mr. Moore:

Subsurface Detection Investigations Inc. (SDII) is pleased to submit the final report for the above referenced project. Our investigation was conducted in accordance with our Proposal Number 93418 dated June 1, 1993. The final report includes a summary of the methodology and results of our investigation.

SDII appreciates the opportunity to have assisted Laidlaw Environmental Services, Inc. on this project. If you have any questions or comments about the report, please contact us.

Sincerely,

SUBSURFACE DETECTION INVESTIGATIONS, INC.

Thomas L. Dobecki /sac;

Thomas L. Dobecki, Ph.D.
Vice President Operations/Principal Geophysicist

93761

MID-ATLANTIC REGION
7525 Broad River Road
Irmo, South Carolina 29063
(803) 749-0556
(803) 732-0185 FAX

CORPORATE HEADQUARTERS
7381 114th Avenue North, Suite 405B
Largo, Florida 34643
(800) 454-SDII (7344)
(813) 544-5020
(813) 546-6282 FAX

SOUTHWEST REGION
11111 Katy Freeway, Suite 610
Houston, Texas 77079
(713) 461-8929
(713) 465-0919 FAX

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5. Geophysical Log of Boring P-2.
6. Geophysical Log Cross-Section; P-1 to MW-1.
7. Geophysical Log Cross-Section; MW-1 to MW-2.
8. Geophysical Log Cross-Section; P-2 to MW-2.
9. Geophysical Log Cross-Section; P-1 to P-2.

1.0 INTRODUCTION

1.1 Background

Subsurface Detection Investigations, Inc. (SDII) was authorized by Mr. Sam Moore of Laidlaw Environmental Services, Inc. (Laidlaw) to perform a geophysical investigation within a series of boreholes and monitor wells at their R&D Facility site near Colfax, Louisiana. Each of five wells was logged using geophysical measurements to provide more detail of the subsurface stratigraphy at each well site and to assist in, possibly, being able to correlate units from well-to-well across the site.

1.2 Purpose and Scope

The purpose of this investigation was to utilize geophysical measurements to help identify specific sand and clay layers within five specified wells. Analysis of cuttings returned during the drilling of the well did not provide a precise characterization of the actual depths and thicknesses of individual layers nor did it allow for correlation of layers across the large separation distances of one well to another across the site. SDII implemented the following scope of work to complete this investigation:

- Log each of the five wells using electromagnetic induction (conductivity) and natural gamma radiation (NGR) methods; and
- Prepare a final report that summarizes the methodology and results of the logging survey.

1.3 Site Description

The project site is located a few miles north of Colfax, Louisiana and serves as a site for the destruction of out-of-date munitions for the armed services. A new segment of the facility is being planned for the site, and a geological assessment of the site is being performed by ViroGroup, Inc. (Baton Rouge) for Laidlaw. ViroGroup has drilled five boreholes (MW-1, MW-2, P-1, P-2, and P-3) at four corners of the, approximately, 800 ft by 500 ft area of concern. The five wells which were logged were accessible at each corner of the rectangular site (Borings P-3 and MW-1 were within 50 ft of each other in the NW

site corner). Each well had been drilled and cased to total depth with PVC casing. The monitor wells also had protective steel casing risers above ground level.

The site was under construction, so numerous trucks, backhoes, trackhoes, and bulldozers were active on and around the site. The site area had been cleared of vegetation.

2.0 METHODOLOGY

2.1 Equipment and Principles

SDII employed the Geonics Model EM39 geophysical borehole logging system to log the five boreholes. The EM39 system consists of a tripod/sheave assembly, a logging instrument (sonde), a recording console, and a cable/winch assembly. The EM39 employs two sondes for making the geophysical measurements: one sonde measures electromagnetic conductivity and a separate sonde measures natural gamma radiation. The sonde is attached to the end of the logging cable and the sonde is lowered into and withdrawn from the borehole. The sheave unit contains an electro-optical device which provides depth measurement (cable length). The depth measurement plus the reading from the probe are transferred via the cable to the recording console. The sonde measurement is converted to the appropriate physical value (either electrical conductivity or natural gamma radiation counts) at the console. The console is controlled by a laptop computer which records and displays the log data in real-time and also stores the log as a digital file. The digitization rate is field selectable and was chosen as 0.1 meter (4-inch) resolution for this project. The operating principles of the conductivity and gamma probes are discussed below.

The electromagnetic conductivity (also called "induction") log operates on the same principles as such common household devices as a doorbell and an automotive alternator. The probe consists of two wound coils - a transmitter and a receiver coil. The transmitter coil is driven with an alternating electrical current. The current in the coil causes an alternating magnetic dipolar field through and surrounding the coil (just like the electromagnet in a doorbell). This alternating magnetic field interacts with the geologic materials surrounding the borehole and causes small alternating electrical currents to flow (by induction) in these materials. This is similar to how an alternating magnetic field in a coil causes current generation in our car's alternator. As with the transmitter coil, the currents flowing in the geologic materials cause their own magnetic fields. The receiver coil merely senses local magnetic fields; therefore, it sees the primary field caused by the transmitter and also the weak fields caused by the geologic materials surrounding the wellbore. After accounting for the primary field, the recording console produces a

measurement which is directly related to the value of electrical conductivity (inverse of electrical resistivity) of the geologic formations. The conductivity log is affected by the presence of water, the salinity of the water, and the presence of clay. Each of these tend to cause increased conductivity measurements. This particular log is valuable because it can be recorded in air-filled as well as PVC-cased wells. The boreholes at this site were PVC-cased, so the induction log is the only means possible to determine formation electrical conductivity.

The natural gamma radiation log is merely a scintillation counter which responds to the natural emanation of gamma radiation in earth materials. The most ubiquitous gamma emitting mineral species are Potassium, Uranium, and Thorium. By far, Potassium-40 is the most common and occurs associated with clay minerals. As such, the NGR log is an excellent means of discriminating sands from clays as clay formations produce high gamma counts. It is a very useful adjunct to the induction (conductivity) log as it helps determine if a rise in conductivity is due to increased clay content or is due to pore fluid changes.

2.2 Field Procedures

The geophysical logging investigation was conducted on July 20, 1993. Five wells were logged to depths as given.

Boring P-1	141 ft
Boring MW-1	135 ft
Boring P-3	53 ft
Boring MW-2	39 ft
Boring P-2	154 ft

3.0 RESULTS

3.1 Geophysical Log Interpretation

P-1

This well is in the SW corner of the site and was constructed using a concentric casing: large outside casing to approximately 50 ft below land surface (bls), central casing to the total depth of the well. Figure 1 reproduces the Conductivity and Gamma logs for this well. In a gross sense, we see that the upper 60 ft of the well is, dominantly, sandy with a well defined, apparently clean sand from 28-59 ft depth and a shallower, clayey sand interval from about 12-28 ft. The increased conductivity from 12-28 ft does not agree with a decreased gamma over this same interval. We interpret this as being sandy (because of the decreased gamma) and feel that the rise in conductivity is due to water in the annulus between the two casings. From 60-122 ft, the section is dominantly clay (high conductivity plus increased gamma) although several thin sands are apparent (depths of 72 and 82) as well as one thicker sand from 90-103 ft. The hole encounters another clean sand from 123-134 ft and bottoms in clay. Although not presented in this report, seismic refraction near Boring P-2 shows a quite hard layer at an approximate depth of 10-12 feet which corresponds to the sand seen on the logs. This combination suggests that the sand is quite hard and, so, has some cementation.

MW-1

This is one of two wells (along with P-3) in the NW corner of the site. The upper few feet of the log is not useful because of the steel riser on the well. The logs from this well (Figure 2) show a significantly increased thickening of the middle clayey section as seen in Boring P-1; this thickening is gained at the expense of a decreased thickness of the upper sandy interval. The gamma ray log suggests very little sand in the upper part of this well. The rise in conductivity is more than likely due to increasing water saturation with depth. The same, deep sand as seen in P-1 is also seen in MW-1 although it is quite a bit thicker (from 103-128 ft depth or 25 ft thick) than in Boring P-1 (13 ft thick). This suggests, as will be detailed later, that continuity and correlation of subsurface strata are more dominant in

the deeper section. It would appear that the upper tens of feet are quite mixed and/or eroded and discontinuous.

P-3

This shallow (53 ft deep) well is about 50 ft east of MW-1. The log (Figure 3), also, shows a dominantly clay section although there is some indication of sand or silt in the upper 5-6 ft. Again, there is a sharp rise in conductivity below 30 ft depth but without an accompanying rise in gamma count. This rise in conductivity is likely due to water saturation. There may be some sandy intervals (e.g. at 16 and 29 ft depth), but these are thin. The thick, shallow sand interpreted in Boring P-1 does not appear to exist in this part of the site.

MW-2

This is a shallow (39 ft bls) well in the NE corner of the site on the edge of an elevation rise to the east. Again, the upper few feet of the conductivity log are distorted by the presence of the steel riser. The logs (Figure 4) show a well-defined clay with a few sand stringers in the upper 11 ft. This is followed by a well-defined, clean sand from 11-32 ft. This boring bottoms in a clay formation. In terms of elevation, this sand layer is very similar (a few feet higher) to the clean sand seen in Boring P-1.

P-2

This deeper well is in the SE corner of the site, some 350 south of Boring MW-2. Its log (Figure 5) shows a, dominantly, clayey section below the first ten feet. Both the conductivity and the gamma show a gradual rise from about 10-45 ft which is interpreted as being due to increasing water saturation and a gradual increase in the clay content. There are some, apparent sand layers (e.g. at 20-26 ft, at 52 ft, at 101-110 ft, and at 120-130 ft), but these are thin. The boring bottoms in sand (from 136 ft to total depth of 154 ft) which is apparently clean judging by the low conductivity and very low gamma counts.

3.2 Cross-Section Analysis of Geophysical Logs

Another function of the geophysical logs is assistance in correlating layers from one well to another. Four cross sections (around the four sides of the site rectangle) are presented as Figures 6-9.

P-1 and MW-1

This section (west edge of site, Figure 6) shows the lack of correlation in the shallow section and fairly good correlation of the deeper section. The deep sand in both wells changes thickness, occurring at the same, approximate elevation in both wells. The shallow sand seen in P-1 is not present in MW-1; a fact also seen in the seismic refraction data.

MW-1 and MW-1

This section (north edge of site, Figure 7) does not provide any clear relationships because of the shallow depth of MW-2. We do see that the shallow sand is back again in MW-2 while it is missing in MW-1. In this sense, the shallow sections of P-1 and MW-2 actually correlate quite well. Perhaps this shallow sand is a channel sand and P-1 and MW-2 both intersect it.

P-2 and MW-2

This section (east edge of site, Figure 8) also suffers from the shallow depth of well MW-2. The shallow sand of MW-2 is not found in P-2, or, if existent at P-2, it is very much thinner (3 ft as opposed to 20 ft). If this shallow sand is a channel, then P-2 is either out of the channel or on the channel edge.

P-1 and P-2

This final section is along the south edge of the site (Figure 9). These two wells correlate quite well in the deeper (below elevation 120 ft) section of the wells but not in the shallow section. Below 120 ft elevation we see a correspondence of the deep sands at the bottoms of each well and even some of the thinner sands in the dominantly clay section above (e.g. from elevation 76 to 96 ft). Above elevation 124 ft, however, the two wells are quite dissimilar.

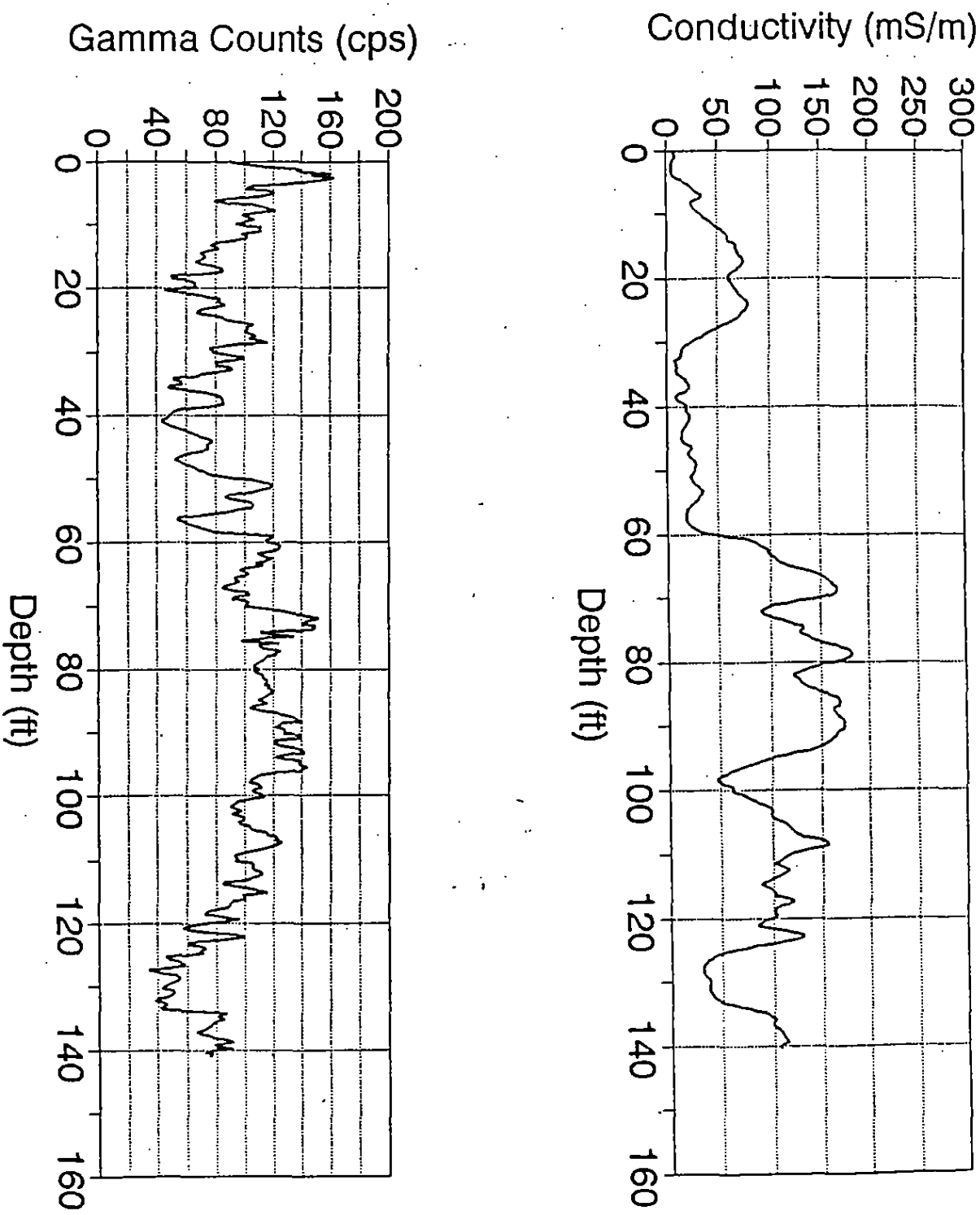
4.0 LIMITATIONS

The geophysical assessment of the borings at this site is based upon our professional evaluation of the geophysical data gathered and our experience with electrical and natural gamma ray log properties of the geologic materials found in this area. The geophysical evaluation rendered in this report meets the standards of care of our profession. No other warranty or representation, either expressed or implied, is included or intended.

FIGURES

Boring P-1

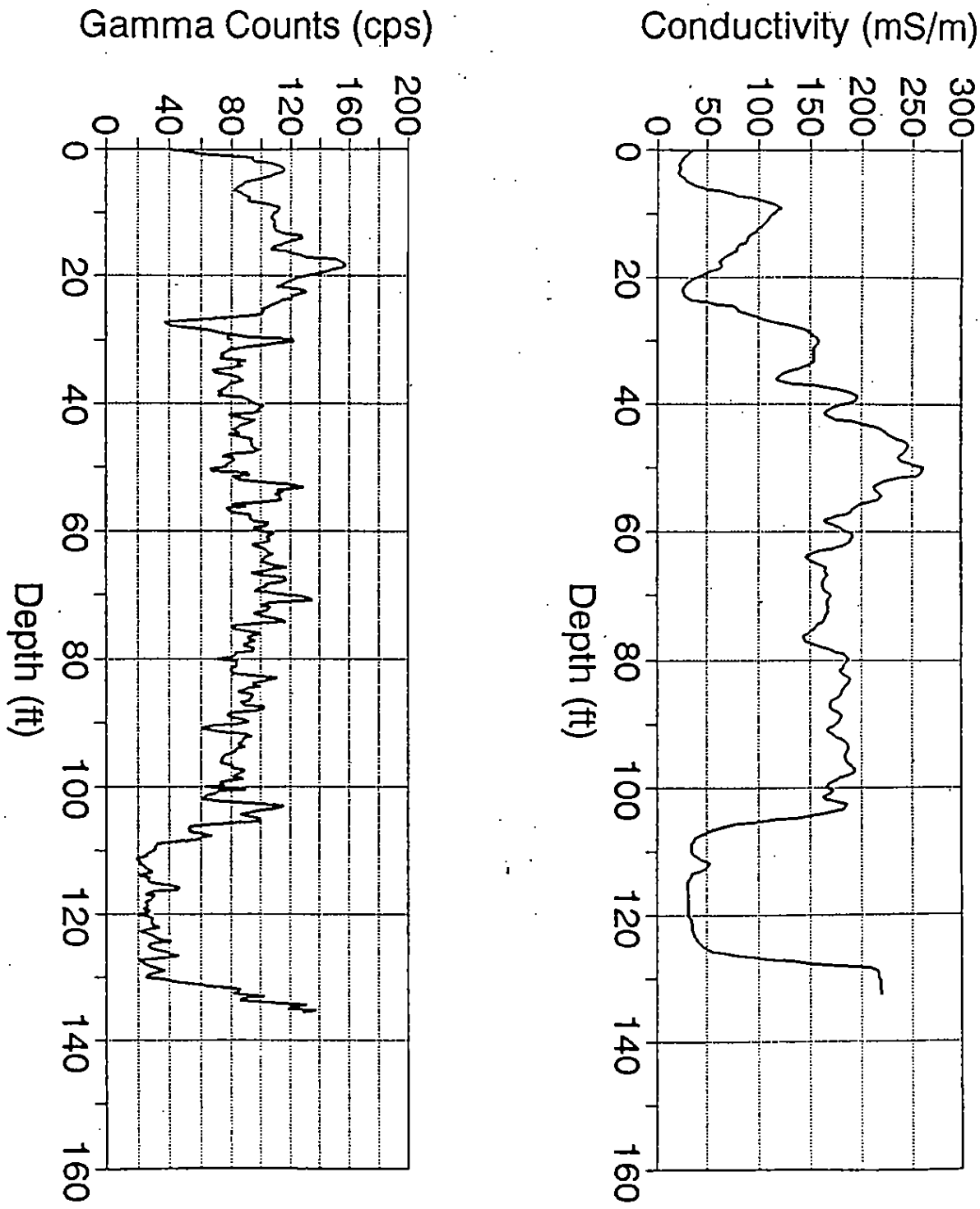
Surf. Elev. = 184 ft



LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG OF BORING P-1 COLFAX R&D FACILITY – COLFAX, LOUISIANA			
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LOG P-1 DATE: 07/29/93	FIGURE 1	

Boring MW-1

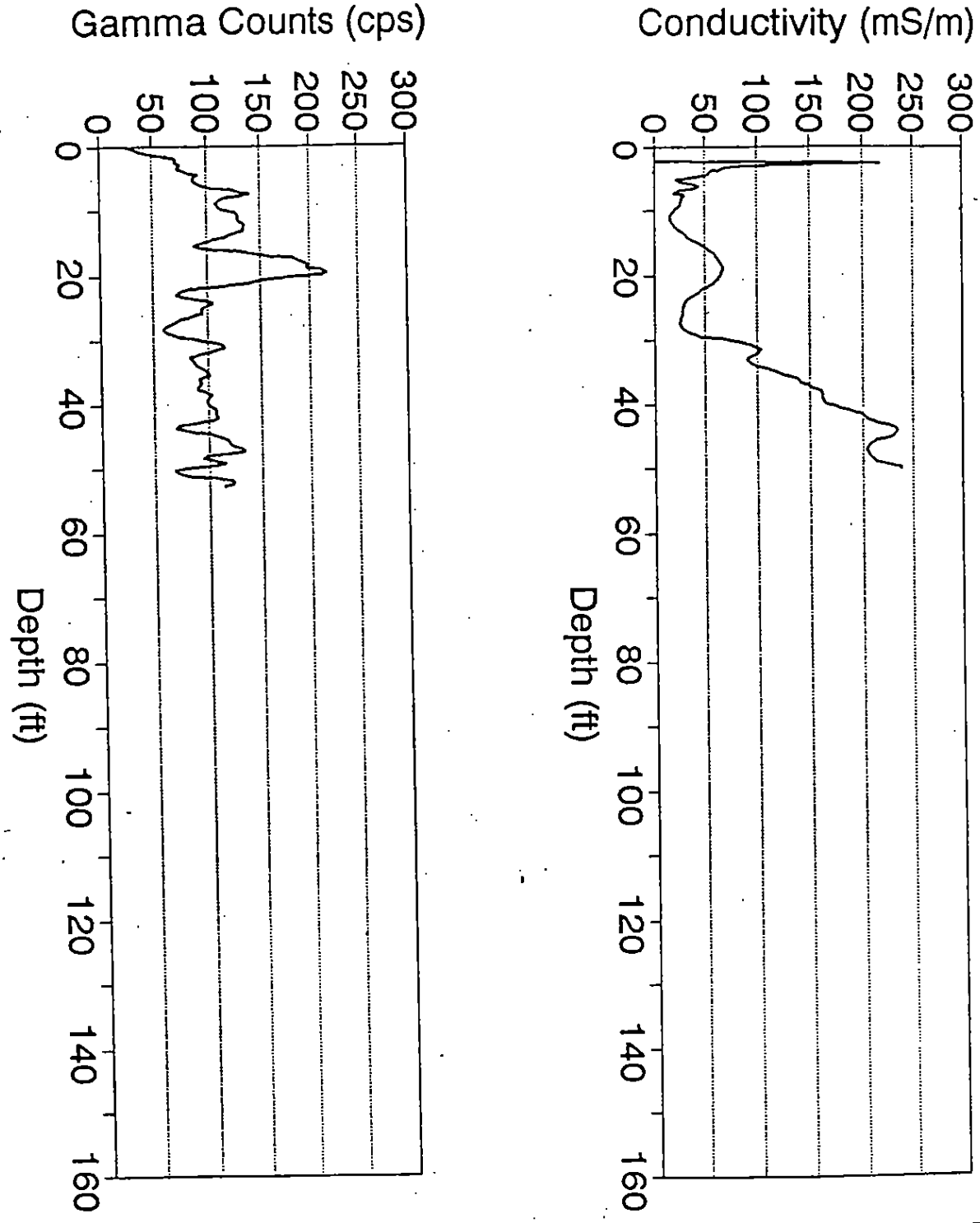
Surf. Elev. = 169.4 ft



LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG OF BORING MW-1 COLFAX R&D FACILITY – COLFAX, LOUISIANA			
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LOG MW-1 DATE: 07/29/93	FIGURE 2	

Boring P-3

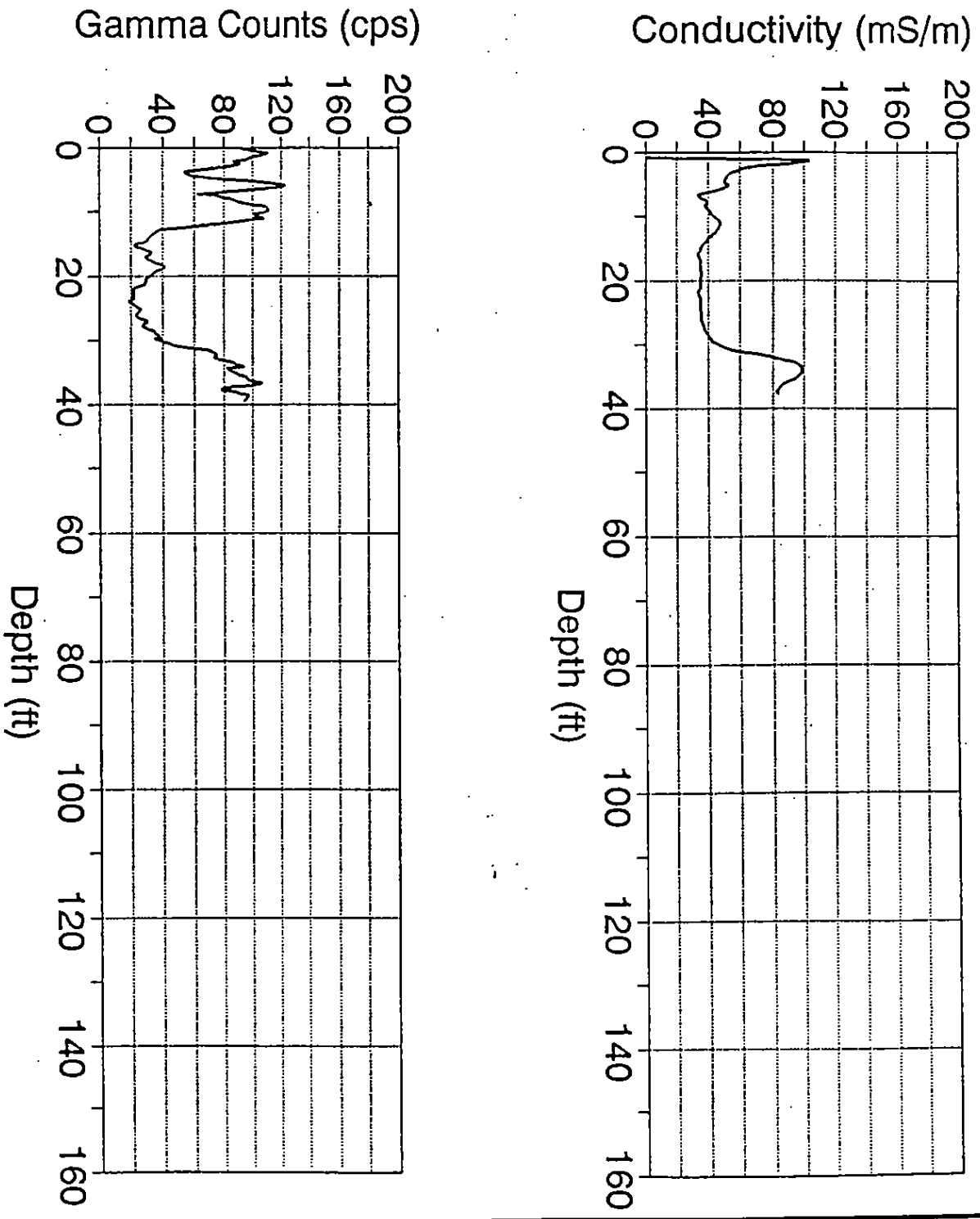
Surf. Elev. = 169.4 ft



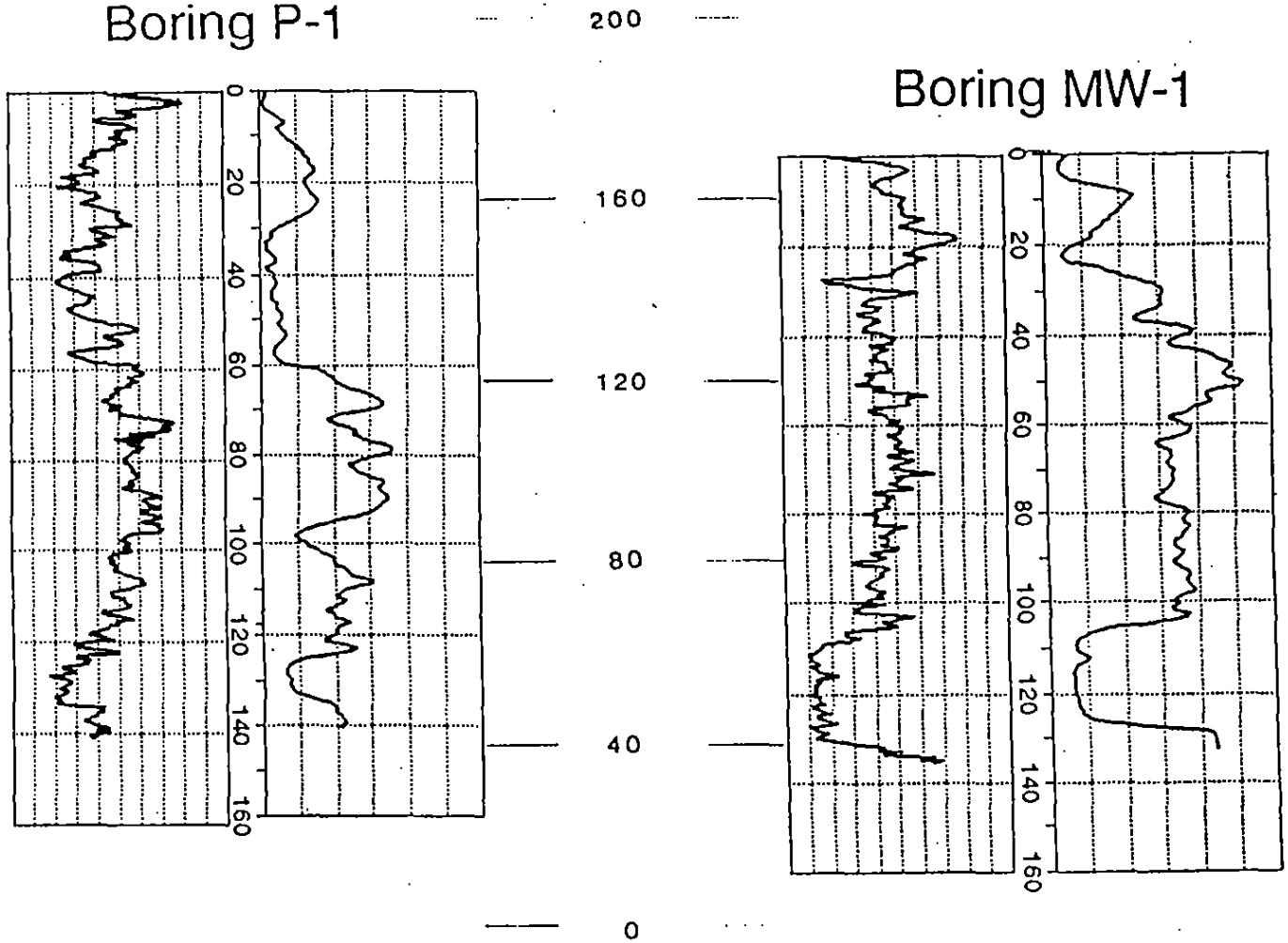
LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG OF BORING P-3 COLFAX R&D FACILITY – COLFAX, LOUISIANA			FIGURE 3
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LOG P-3 DATE: 07/29/93		

Boring MW-2

Surf. Elev. = 163.2 ft



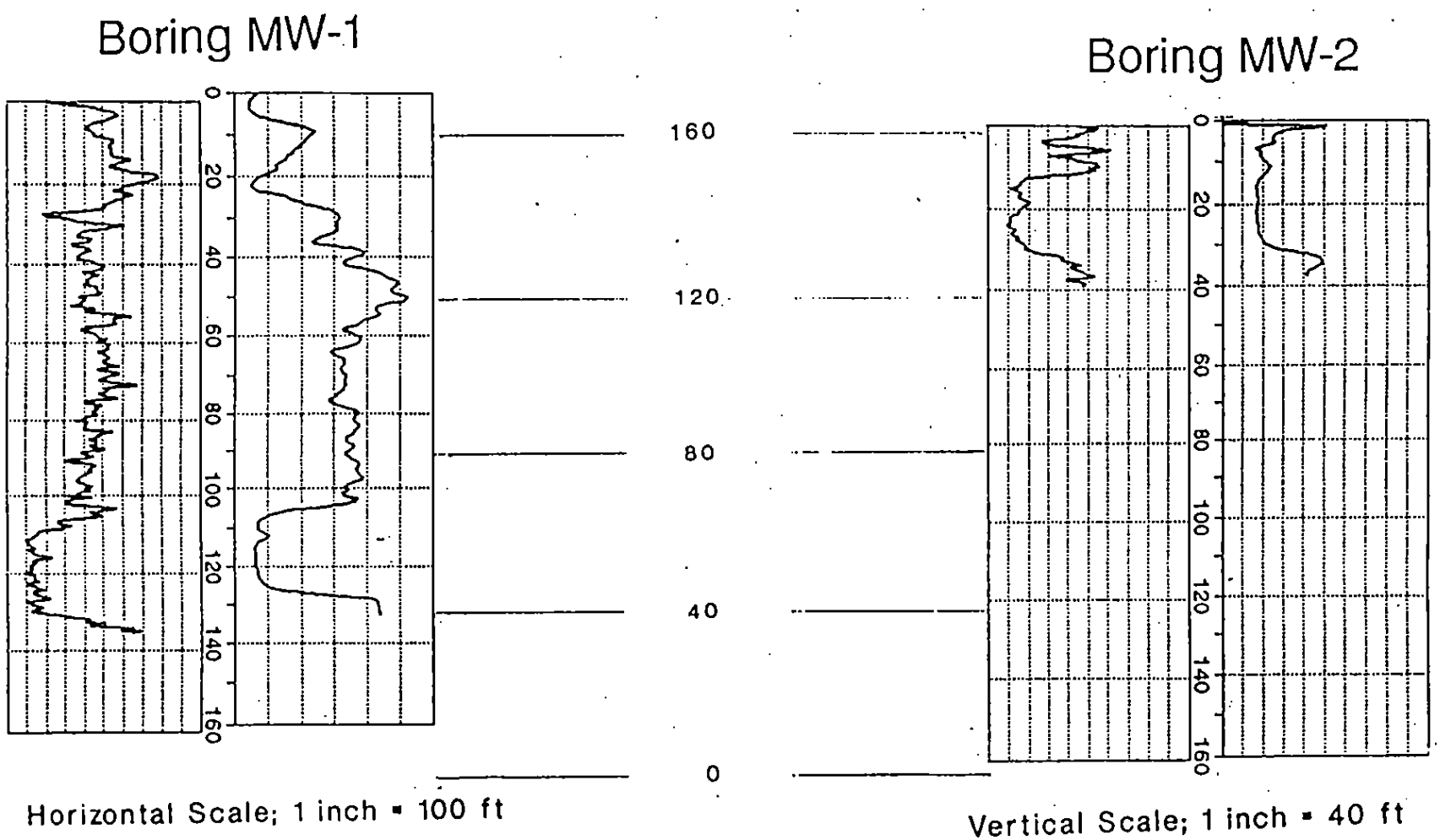
LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG OF BORING MW-2 COLFAX R&D FACILITY – COLFAX, LOUISIANA		FIGURE 4
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LOG MW-2 DATE: 07/29/93	



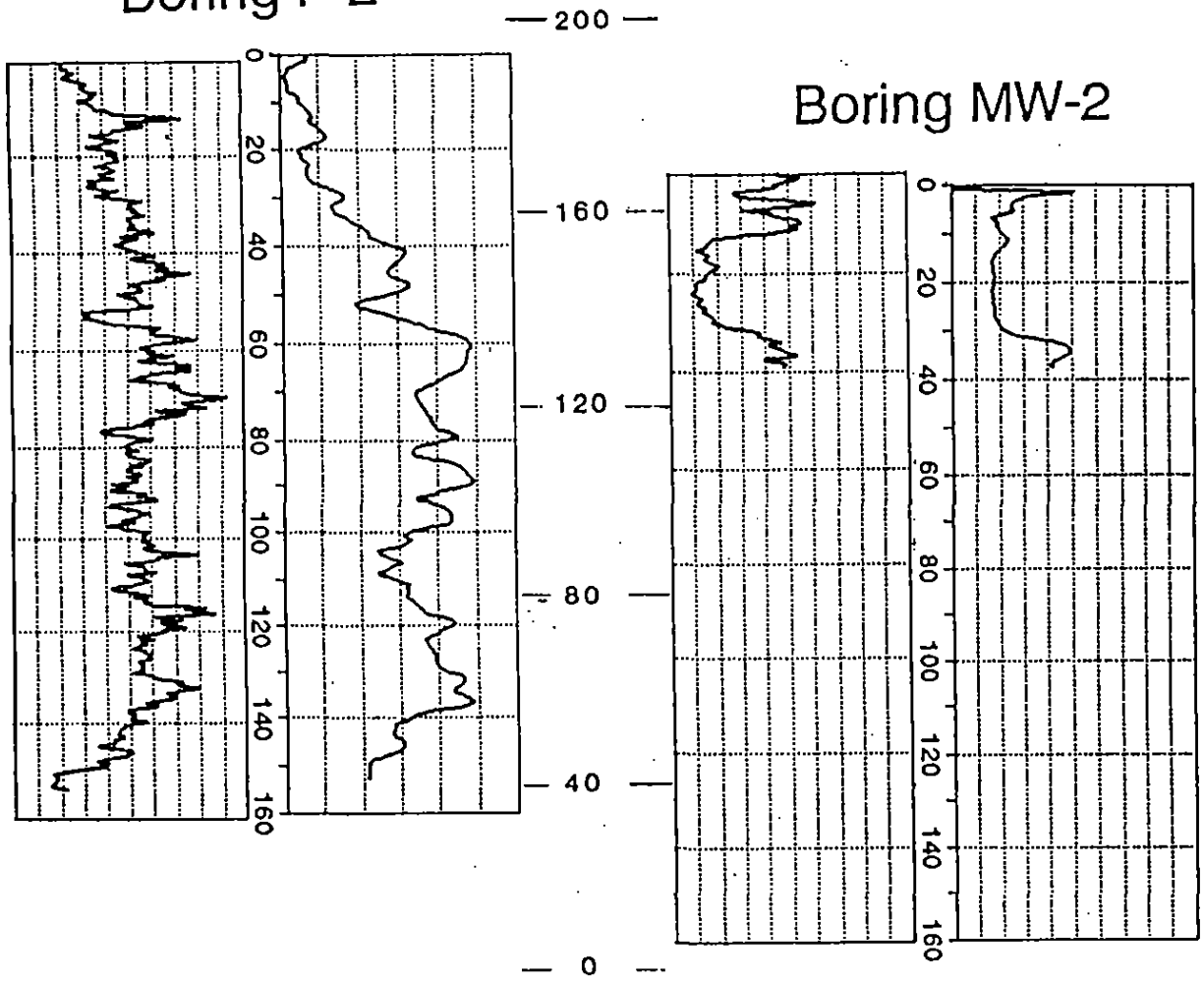
Horizontal Scale; 1 inch = 100 ft

Vertical Scale; 1 inch = 40 ft

LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG CROSS-SECTION; P-1 TO MW-1 COLFAX R&D FACILITY – COLFAX, LOUISIANA		
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LG-2 DATE: 07/29/93	FIGURE 6



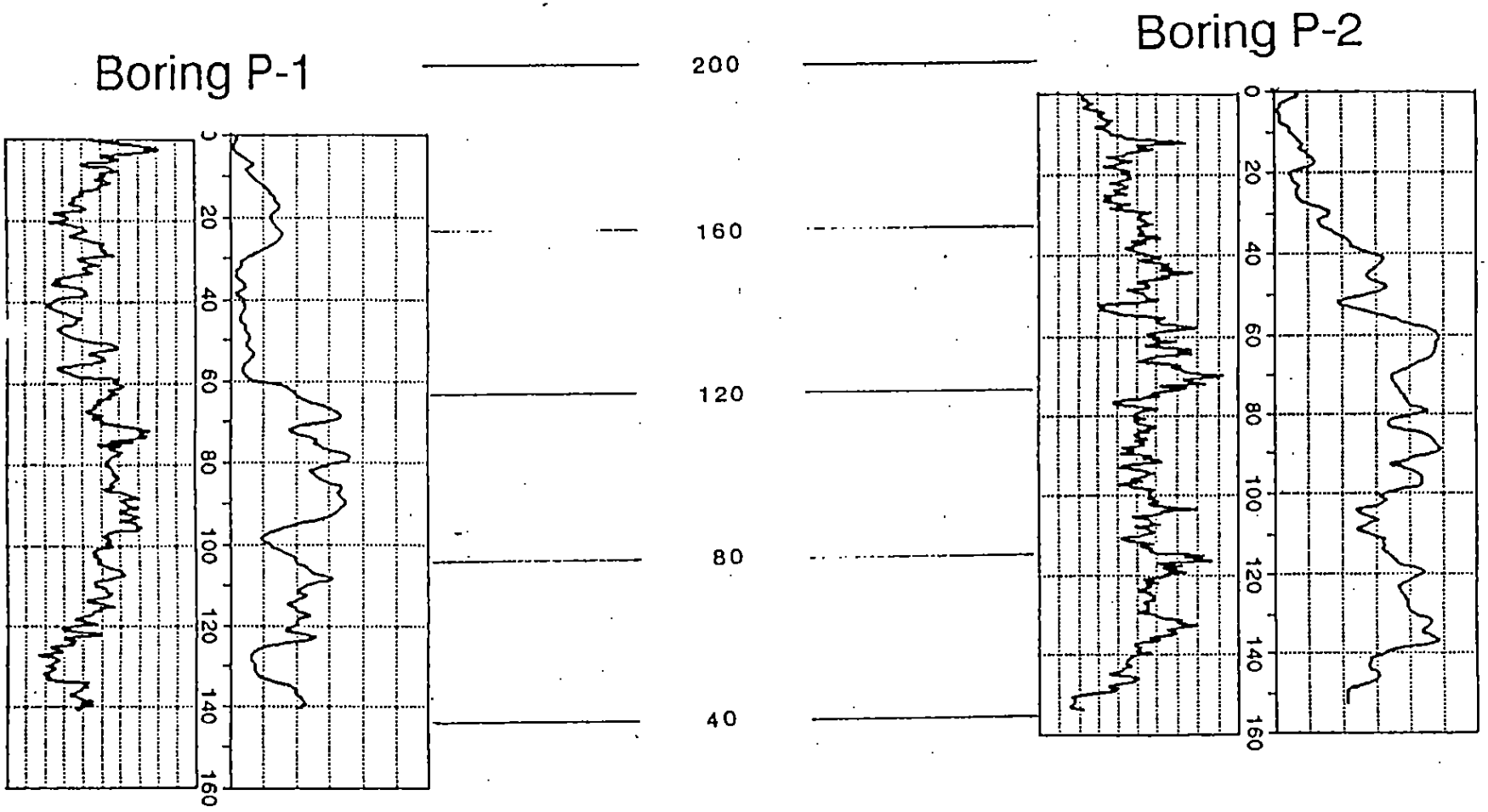
LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG CROSS-SECTION; MW-1 TO MW-2 COLFAX R&D FACILITY – COLFAX, LOUISIANA		FIGURE 7
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LG-2 DATE: 07/29/93	



Horizontal Scale; 1 inch = 100 ft

Vertical Scale; 1 inch = 40 ft

LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG CROSS-SECTION; P-2 TO MW-2 COLFAX R&D FACILITY – COLFAX, LOUISIANA		
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LG-2 DATE: 07/29/93	FIGURE 8



Horizontal Scale; 1 inch = 100 ft

Vertical Scale; 1 inch = 40 ft

LAIDLAW ENVIRONMENTAL SERVICES, INC. COLUMBIA, SC	SDII SUBSURFACE DETECTION INVESTIGATIONS INCORPORATED	GEOPHYSICAL LOG CROSS-SECTION; P-1 TO P-2 COLFAX R&D FACILITY -- COLFAX, LOUISIANA		
		DESIGNED BY: TLD CHECKED BY: RJW DRAWN BY: SBG	PROJECT NO.: 93761 DRAWING NO.: LG-2 DATE: 07/29/93	FIGURE 9

APPENDIX 2-F

SDII SEISMIC STUDIES

AUG 16 1993

AUG 16 1993

FINAL REPORT

SEISMIC GEOPHYSICAL SURVEYS

COLFAX R&D FACILITY
COLFAX, LOUISIANA

Prepared For:

LAIDLAW ENVIRONMENTAL SERVICES, INC.

COLUMBIA, SOUTH CAROLINA

AUGUST 1993

SDII
SUBSURFACE
DETECTION
INVESTIGATIONS
INCORPORATED

August 13, 1993

Laidlaw Environmental Services, Inc.
P.O. Box 210799
Columbia, SC 29221

Attention: Mr. Sam Moore

Subject: **Final Report - Seismic Geophysical Surveys**
Colfax R&D Facility, Colfax, Louisiana
SDII Project No. 93777

Dear Mr. Moore:

Subsurface Detection Investigations Inc. (SDII) is pleased to submit the final report for the above referenced project. Our investigation was conducted in accordance with our Proposal Number 93455 dated July 12, 1993. The final report includes a summary of the methodology and results of our investigation.

SDII appreciates the opportunity to have assisted Laidlaw Environmental Services, Inc. again on this project. If you have any questions or comments about the report, please contact us. I have forwarded one copy of this report to Mr. Alan Piechocki.

Sincerely,

SUBSURFACE DETECTION INVESTIGATIONS, INC.

Thomas L. Dobecki, Ph.D.
Vive President Operations/Principal Geophysicist

93777

1.0 INTRODUCTION

1.1 Background

Subsurface Detection Investigations, Inc. (SDII) was authorized by Mr. Sam Moore of Laidlaw Environmental Services, Inc. (Laidlaw) to perform a seismic geophysical investigation at their R&D Facility site near Colfax, Louisiana. An area circumscribed by a series of five test wells was surveyed using seismic refraction and reflection measurements to provide more detail of the subsurface stratigraphy and structure between those borehole locations.

1.2 Purpose and Scope

The purpose of this investigation was to utilize geophysical measurements to help identify and track the continuity of specific sand and clay layers along transects surrounding the site and through its middle. Analysis of boring logs and borehole geophysical logs within the five wells show this site to have rather complex subsurface geology. In addition, fracturing seen in shallow samples taken during drilling suggests possible deformation of shallow formations. The problem on site, as is typical, is that the complexity of the subsurface geology is not adequately defined by the few, widely spaced borings. Seismic surveys were proposed as a means of interpreting geologic structure between the borings. SDII implemented the following scope of work to complete this investigation:

- Perform a seismic refraction survey and a seismic reflection survey around the perimeter of the site and along a single line through the center of the site and
- Prepare a final report that summarizes the methodology and results of the seismic surveys.

1.3 Site Description

The project site is located a few miles north of Colfax, Louisiana and serves as a site for the destruction of out-of-date

munitions for the armed services. A new facility segment is being planned for the site, and a geological assessment of the site is being performed by ViroGroup, Inc. (Baton Rouge) for Laidlaw. ViroGroup has drilled five boreholes (MW-1, MW-2, P-1, P-2, and P-3) at four corners of the, approximately, 800 ft by 500 ft area of concern.

The site was actively under construction, so numerous trucks, backhoes, trackhoes, and bulldozers were running on and around the site (high vibration noise). The site area had been stripped of vegetation and was, therefore, rather dusty. Certain areas of the site had also been excavated below ground level allowing exposure of subsurface stratigraphic units to at least 6-10 ft depth.

The site geology is dominated by clastics (sands, sandstones, and clays). The sands ranged in hardness from very loose soils to very hard (but still rippable) sandstones very near the ground surface. Where exposed in trenches, some of the clays are quite stiff/hard although not as hard as some of the near surface sandstones. The previous borehole logging program suggests that deeper (>60 ft, typically) units are probably continuous or at least correlatable, across the site, but that the shallower units are likely discontinuous.

2.0 METHODOLOGY

2.1 Equipment and Principles

Seismic refraction is a geophysical method which is sensitive to the elastic constants of the subsurface materials - specifically as they affect the seismic propagation velocity of various media. Significant factors which determine seismic propagation velocity of a medium include: fluid saturation, porosity, degree of fracturing, density, and rock type. Refraction is sensitive to both lateral changes in material velocity (e.g. at the edge of a landfill) or a change in the vertical layering (e.g. the water table). The principal requirement to determine the vertical layering using refraction, however, is that the velocity increase with depth. This is the normal circumstance, however, as typified by dry over wet soils, loose over compacted sediment, and sediment over rock situations.

The method requires the use of a seismograph (a sophisticated timing device), an energy source to impart elastic waves into the ground (usually a sledgehammer), and sensors (geophones) which record the vibrations set up by the source (see figure 1). To perform a refraction survey, we record the time it takes for a seismic wave to travel from the source to a series of geophones, in a line, at progressively greater distances from the source. The more distant receivers provide information about deeper layers while the near receivers are sensitive to shallow layers. For a simple, two-layered case (like loose over compact soil), seismic refraction will determine the depth to the compacted layer and determine the velocity values for both the loose as well as compacted layer. The velocity is a measure of the material strength.

Seismic reflection (also figure 1) is similar to seismic refraction in several respects in that they use the same equipment, seismic sources, and general field set-up procedures. They differ, however, in the nature of the recorded information as well as how

they work (the basic physics). Reflection records waves which are reflected from contrasting layers in the subsurface (layers with differing seismic velocity and/or mass density). Whereas seismic refraction can only map a transition from a softer material to a deeper, harder material, seismic reflection can also map a transition from a harder to a softer material. Seismic reflection can, therefore, map the presence and thickness of a clay layer beneath a hard sandstone; seismic refraction can only map the depth to the top of the hard sandstone. In general, seismic reflection is a more difficult technique to apply, but when successful, it is capable of seeing deeper and with greater detail than using seismic refraction. We felt that the combination of the two techniques was necessary to adequately describe the site subsurface geology.

SDII employed the EG&G Geometrics, Model ES2401 seismograph system to record both the refraction and reflection data sets. This system is a 24-channel, digital recording system. The source employed was a sledgehammer blow to a steel plate. This source was preferred after initial testing of a variety of sources including: electrical blasting cap, 12 gauge shotgun shells detonated in a shallow hole, and an 8 gauge shotgun shell detonated in a shallow hole. Because of the dry, loose condition of the surficial soils, none of the energy sources tried yielded high frequency data (because of attenuation of higher frequencies in the dry soils). The hammer offered equal data quality to the others but offered the advantage of speed (no requirement to drill shallow source holes). A total of ten hammer blows added together produced the required energy input into the earth for survey purposes.

2.2 Field Procedures

The seismic investigation was conducted on July 21-23, 1993. On July 22 and 23, seismic activities were extended into the evening in order to acquire data during quiet hours after the construction crews had departed for the day. A series of five seismic lines as indicated, generally, on figure 2 were acquired. The lines were defined as follows:

Line 100	350 ft long	From Borings P-2 to MW-2
Line 200	470 ft long	From Borings P-1 to P-3
Line 300	600 ft long	From Borings P-3 to MW-2
Line 400	630 ft long	From Borings P-1 to P-2
Line 500	390 ft long	From Line 300 to Line 400

Each line was first laid out on the ground using a tape measure, spray paint, and pin flags. Key points for elevation control were staked with 3 ft wooden stakes. Ground surface elevations of these staked positions were determined after completion of the seismic survey. Acquisition of the seismic data (both refraction and reflection) consisted of:

- Layout from 24 to 48 geophones at 10 ft intervals along the specific seismic line being acquired
- Attach geophones to seismic cable and attach cable to seismograph
- Position the hammer/plate source at the appropriate position (different locations for refraction and reflection)
- Stack (add) ten hammer blows and store the resulting seismogram on floppy disk for subsequent processing
- Move to next hammer position and repeat
- Continue process through end of line

3.0 RESULTS

3.1 Seismic Refraction

For each of the following line descriptions, the data were processed using a computer program ("SIPT2") originally developed by the US Bureau of Mines and USGS. The program takes times and distances from the stored seismogram records and produces a depth cross section. The basis of the depth cross section is seismic velocity. That is, the program output is a layered model showing the depth and structure of interfaces (layer boundaries) between materials of differing seismic velocities. For example, figure 3 shows the basic input time versus distance curves for a seismic refraction setup along one of the lines. Displayed is time of refraction arrival (vertical axis) versus distance along the line for a series of five shotpoints. The lines drawn on the figure are our best estimate of velocity layering. That is, very near the shotpoints we see an initial, high sloping line which represents very low velocity; this line represents arrivals through the surficial, loose soils. At a short distance from any shotpoint, we see a change in slope (a second line) which represents a harder layer. Further still from any shotpoint, we see another change in slope to even faster (harder) materials at greater depth. Almost all lines on site showed such a three-layered subsurface on the refraction data. The general section, using average velocities, we see, then, is:

1. An upper layer of surficial soils (V_1 = 1000 ft/sec)
2. A deeper (5-10 ft depth, typically) layer which is harder (average V_2 = 3500 ft/sec) which we interpret as being a stiff clay
3. A still deeper (range from 10-40 ft depth) and harder (V_3 = 5500 ft/sec) layer which, when present, we interpret as being a hard sandstone layer.

Wherever possible, we try to correlate the seismic results with the results of nearby trenching and the results of the borehole logging.

Line 100 - This line is a short line linking Borings P-2 and MW-2 along the, generally, eastern edge of the site area. Boring P-2 is up on a small hill, so there is some topographic relief on the line. Nearby excavation activities and tree removal activity have exposed numerous large blocks of sandstone from the shallow subsurface.

The interpreted refraction depth section for this line (figure 4) is unique among the lines acquired as it only shows two layers: weak soils (V1 = 910 ft/sec) and the harder sandstone layer (V2 = 5560 ft/sec). This is likely because the clay in this area may not be as stiff as other areas and also because it (the clay) is rather thin to begin with. We see that the interpreted top of the second, hard layer agrees very closely with the top of the shallow sand as seen in the borings at each end of the line and with the fact that sandstone was brought up in the process of tree removal. The sand seen in Boring P-2, however, is rather thin and not as clean as seen in MW-2 (see the report on the geophysical logging of these wells). Because refraction can only map a transition from soft to hard materials, we can only map the surface of the sand and not the top of the underlying, softer clay. The surface of the sandstone layer stays rather shallow (<10 ft below ground surface) and parallels the ground surface along this line. The sandstone is hard but is still not very well cemented and is rippable according to published excavation standards (sandstone; velocity less than 6000 ft/sec).

Line 200 - This is also a short line but is along the western edge of the site area linking Borings P-1 and P-3/MW-1. In (approximately) the middle of this line, the contractors excavated a rather large trench. This trench showed a thick, hard clay layer at about 3-5 ft depth which continued to the bottom of the trench (10-12 ft). No sandstone was encountered. In the field, we noted peculiar behavior of the refracted arrivals on the seismic data. Near boring P-1 and for 120 ft along the line towards P-3, a very hard layer is seen at rather shallow depth (sandstone). This

layer, however, either truncates or deepens as shown on the seismic interpretation (figure 5). While we still see three layers (soil, intermediate, and hard layers), we see that the depth to the hard sand layer is quite shallow near Boring P-1 (consistent with the thick shallow sand seen in P-1) and deepens abruptly to the north (right). As noted in the Borehole Logging Report, the thin, clean sand in P-1 is not present or interpreted in Borings MW-1 or P-3. This suggests that the sand at P-1 could be a channel sand of limited width. While the refraction just shows this (layer 3) as a continuous, although deepening, interface, it is more likely that the hard layer (layer 3) is actually discontinuous. That is, the layer 3 on the left is a different layer than the layer 3 on the right. There is a thin sand in MW-1 at an elevation close to the layer 3 elevation on the right. We also feel the thick, intermediate velocity layer (layer 2) in the central portion of the line is the stiff clay seen in the excavation.

Line 300 - This line is a longer (600 ft) line along the northern site boundary linking Borings MW-1/P-3 with shallow Boring MW-2. The ground surface slopes gradually down to the southeast except for a small drainage feature (see ground surface on figure 6). The refraction portion of this line was not continued all the way to the end of the line. The refraction results show, again, a three layer subsurface. The soils (upper layer) show quite a bit of thickness variation generally being thickest in the area of the drainage feature. The hard layer (sandstone?) remains deep (>15 ft) except for the very ends of the line. We feel the shallowing of this layer towards the east (right) is significant in that we are approaching well MW-2 which has the clean, hard sand at very shallow depth. The trend on the seismic line is for the deep layer to shallow approaching MW-2. This is a similar situation to Line 200 near well P-1 where the deep layer is seen to shallow rapidly (at the edge of a discontinuous sand body?).

Line 400 - This line parallels the southern edge of the site area

linking borings P-1 with P-2. The ground surface, like along Line 300, gradually slopes to the east except in crossing the drainage feature and rising up hill to boring P-2. Near Boring P-1 (see figure 7), we again see the shallow hard (sand) layer as along Line 200. The sand deepens (or truncates) some 100 ft southeast of P-1; again the deeper hard layer may be a different, deeper sand body. Going further towards P-2, however, we see the depth to the hard layer decreasing rapidly. This suggests we have either come back on to the same sand body as seen on the early (left) part of the line or have come onto another shallow sand layer since we do see a shallow, thin sand as well as a deeper sand in P-2. As will be seen in the reflection data discussion for this line, this area of rapid change in the depth to the hard layer could be a fault.

Line 500 - This line trends NS through, almost, the middle of the site joining seismic Lines 300 and 400 but does not have any nearby borehole control. The line crosses the site just to the southeast of the large trench excavated near Line 200 and just northwest of the large pit area where much of the excavation had been conducted. The seismic interpretation (figure 8) shows a rather consistently thick intermediate layer (stiff clay?) across the line. We do see some indication of shallowing of the deeper, hard (sand?) layer in the middle of the line and towards the right (north) end. Again, these topographic features interpreted on the top of Layer 3 are likely due to lens-like shapes of some of the sand bodies as we have seen on other lines. That is, the apparent depression in the top of Layer 3 near line location 300 ft may just be a gap between separate sand bodies to the left and right.

3.2 Seismic Reflection

The resulting seismic data files from the reflection program were returned to our Houston office for rather detailed and quite sophisticated data processing. The field data were acquired in the so-called "common midpoint" or "CMP" method. This means that a large redundancy of data was acquired; subsequent processing allows

for resorting of all the many seismic data files and statistically analyzing these to produce a final "CMP Stacked" section with improved signal quality and reduced noise. The numerous processing steps are designed to improve the quality of the final reflection section. These reflection sections are plots of reflected signal at a given line position versus time (increasing downwards) and not true cross-sectional depth. To convert time to depth, we need to know seismic velocities of the various rock masses. We have measured this, although only for the upper tens of feet in the subsurface, using seismic refraction. Therefore, we will attempt to express our interpreted seismic reflection sections in terms of depth as much as possible.

The scaling on the figures is a) reflection time (vertical) ranging from 0 to 0.500 seconds, two way (down and up) and b) line distance horizontally. Line distance, on these figures, is cited in terms of Station Number; Station spacing is 10 ft; so, Station 100 is the start of the line (zero feet distance) and Station 120 (for example) is twenty stations, or 200 ft, along the line. Actual trace spacing on the sections is one-half the station spacing, or every five feet.

The general geologic framework of this area is that we should expect gentle dips to the South to Southeast and faulting would likely be normal (growth) faulting striking, generally, NE and displacement being down to the SE.

Line 100 - The seismic reflection section for Line 100 is given as figure 9. Note that on this section and all following sections, the reflection times shown are referred to a fixed "datum elevation" of +200 ft. That is, even though there is substantial topographic variation along the seismic lines, the times shown are referenced to a flat datum level slightly above the highest actual elevation encountered. This is why, for example, the first energy lineups seen on figure 9 slope slightly to the right. The ground surface also slopes in that direction. The reflections, which we correlate with layer interfaces, are viewed as coherent dark bands

across the section. We try, using assumed or measured velocities, to correlate a specific reflection with a specific geologic interface using the borehole and logging information. On Line 100, we see several reflections ranging from as shallow as 0.030 seconds (approximately 50 ft depth) down to a maximum of just over 0.400 seconds (rough approximation of at least 900 ft depth). There are even shallower (0.020-0.025 sec) events on the record, but these are remanents of the refraction arrivals. While not true reflections, they still do provide some information which is useful in interpreting deeper reflections. The shallower reflections may be correlated with known units because we do have borehole depth control (P-2) down to approximately 150 ft depth. Without deeper control, we can only speculate on what the deeper (>0.080 sec time) reflections represent from a stratigraphic standpoint. We would, however, suspect that these are geologic interfaces, so that we are able to make interpretations on their continuity or lack thereof (e.g. faulting).

On figure 9 and other subsequent reflection sections, we have tried to carry (correlate) specific reflections across the line from one end to the other and also from one line to another. These specific reflections are colored in on the section. Uninterpreted (non-colored) versions of the data are also attached as an Appendix to this report. In reviewing the reflection information on figure 9 (Line 100), we can make the following observations:

- Reflections deeper than approximately 0.070 sec (depth of 150 ft, estimated; colored green on figure) are rather continuous and show a dip component to the left (SW) of approximately 2° or less. These reflections are, generally, very weak owing to the low energy of the seismic source used.
- Also, the deeper reflections, as far as we can see them, do not show any offset or discontinuity which we would interpret as faulting. This line, however, would run almost parallel to any expected faulting if this area is true to suspected geological structural trends.
- The shallow reflections (colored yellow on figure 9) are

believed to correlate with a sequence of sands seen in Boring P-2 and with the thin sand unit seen in boring P-2 at a depth of 50-58 ft.

- The continuity of the shallow sand reflections is only fair. The upper two reflections appear continuous and rather horizontal from the left (start) of the line through Station 120. At this point, the upper reflection becomes mixed in with the refraction arrivals (because of the sloping ground surface, this sand becomes very shallow). The second reflection extends to the right a bit further but appears to either be truncated or pinches out. The third sand (?) reflection we feel correlates with the deep sand seen at the bottom of Boring P-2. It shows as an undulating layer which could either be due to structure (small folds or erosional) on its surface, or it could actually be a sequence of discrete lenses which would give it its appearance of poor continuity.

- The continuity of all shallow events shows a disruption near Station 120 which is seen to exhibit dip to the right (NE); there is a possibility that this could be a small fault. If so, the dip and possible displacement is opposite to what would be expected ("up towards the coast") although such features are common. Mr. Alan Piechocki (ViroGroup, personal communication) has stated that the shallow clays and sands in this part of the site show fracturing. Perhaps the reduced coherency is due to increased fracturing; faulting could be a cause for such fracturing.

Line 200 - The seismic reflection section for seismic line 200 is given as figure 10. While this line does not intersect line 100 (it is parallel to Line 100), it does have deep borehole control (P-1 and MW-1) near each end of the line. Besides, we can try to match similar character of reflections along line 100 and 200.

- Line 200 data also show weak, deep reflections which are consistent with the deep events seen on Line 100. They, too, exhibit nearly horizontal attitude or perhaps a slight dip

component to the left (SW).

- The shallow (<0.100 sec) portion of this line is quite a bit simpler in appearance than the same for Line 100. This is felt due to the thick clay bed seen over most of the line as defined by seismic refraction and by trenching along the line. The very shallow, thick sand seen in Boring P-1 and detected by refraction shows as a shallow, complex reflection on the left side of the record which disappears near Station 112. From that point on, there are several thin and continuous reflections which we feel are within the clay.
- The reflections at approximately 0.050-0.080 sec reflection time correlate with sands seen in P-1 and MW-1. These reflections are rather uneven although we do not see significant breaks or offsets in these. We feel these represent lateral lensing (thickening, thinning, pinching out) of discrete sands within a limited depth interval. This is also consistent when comparing the boring logs which show substantial changes in the thicknesses of correlatable sands.
- We do not see any indications of faulting along Line 200.

Line 300 - The seismic reflection section for seismic line 300 is given as figure 11. This line runs from NW to SE intersecting or nearly intersecting both Lines 100 and 200 at their NE ends. It gradually runs downslope going from left to right except for a deep drainage ditch feature at Station 141-144.

- The same weak, deep reflections are seen on Line 300; in this section, however, these events, where we can follow them, show slight dip to the right (SE). This is consistent with the SW component of dip seen on Lines 100 and 200 and with the general geology of this area having general dip towards the Gulf Coast (i.e. South).
- The shallow section is similar to Line 200 over most of the line in that we see a fairly simple (uncluttered) section above 0.050 sec which we feel indicates more clay in the very shallow section. This is also in agreement with the refraction results.

- We do see some complexity in the interpreted sand reflections however. The shallowest interpreted sand (from Boring MW-1 on the left side of the section appears to pinch out going to the right. It appears that another shallow sand is picked up at the right end which may correlate with the shallow sand seen in shallow boring MW-2 at that end. This again shows that these very shallow sands are discrete bodies which are lens shaped either due to erosion or deposition (channels).
- The deeper sand reflection (based upon correlation with MW-1) is seen to be rather continuous across the entire section. We do see a rise or "hump' on this reflection from Station 140-146, but we feel this is due to the effect of crossing the drainage ditch. This bed is interpreted to be at about 140 ft depth.
- We do not see any indications of faulting along Line 300.

Line 400 - The seismic reflection section for seismic line 400 is given as figure 12. This line parallels Line 300 and intersects Lines 100 and 200 at their SW ends. It also runs downslope to the right except for an abrupt rise going up towards Boring P-2 at the right end. The drainage feature is not quite as deep or noticeable along this line.

- The deep reflections are very weak along this line. They only hint at a slight dip to the right (SE).
- The shallow section on this line is rather complex. The very shallow portion (<0.050 sec) is "busier" than lines 200 and 300 owing to, we suspect, more shallow sands than on those lines (i.e. more hard reflectors than the clay rich near surface on those lines). The several sands seen in Borings P-1 (left side) and P-2 (right side) correlate well with observed reflections.
- All reflections seen are disrupted along a line which starts (time 0.000) at Station 140 and dips down to the left (NW). This would appear to be a fault. It may, owing to its nearness to line 100 be the same feature interpreted on that line. The definition of the feature on Line 400 is much more distinct however, suggesting Line 400 is more closely perpendicular to its

strike. The fact that the disruption is seen along a dipping line makes us believe it is real and not a processing artifact (e.g. if all the disruption occurred over a vertical line which would suggest a few bad traces).

Line 500 - The seismic reflection section for seismic line 500 is given as figure 13. This line parallels Lines 100 and 200 and intersects Lines 300 and 400 towards their midpoints. There is no borehole control for this line.

- The deep, weak reflections again show indication of slight dip to the left (SW).
- The near surface (<0.050 sec) section shows a mix of style being complex to the left (like the suspected shallow sands mid-way along Seismic Line 400) to rather simple to the right (like the dominant, thicker clays suspected midway along Line 300). Indeed, the midpoint of Seismic Line 500 is just east of and below the large trench which encountered thick clays.
- The deep (estimated depth around 140 ft) sand reflection at about 0.070 s time is interpreted to tie well with the same deep sand seen on all the other seismic lines and seen in the deep wells. It shows as being nearly continuous. The undulating surface and the brief losses of reflection strength, however, suggest that it may be adjoining, lens-shaped sand units rather than a continuous, blanket deposit.
- We do not see any indications of faulting along Line 300.

3.3 Seismic Summary

Seismic refraction has shown variable depths to hard layers which we interpret as being sands. Shallow (<20 ft depth) sands seem to exist in, dominantly, the northeastern (between Borings P-2 and MW-2) edge and the southwestern (around P-1) corner areas of the site. Most of the balance of the site shows thick surface clays which agrees with excavations.

Seismic reflection shows that the various sands seen in the borings (to 150 ft depth) can be correlated with discrete

reflections in the shallow seismic data (above 0.080 sec). Other, deeper reflections are seen, but we cannot tie these to known strata. Even though the deepest reflections are weak (owing to a low energy seismic source) they show tendency to have a dip to the South and are rather continuous. Shallow reflections are stronger but are not as continuous.

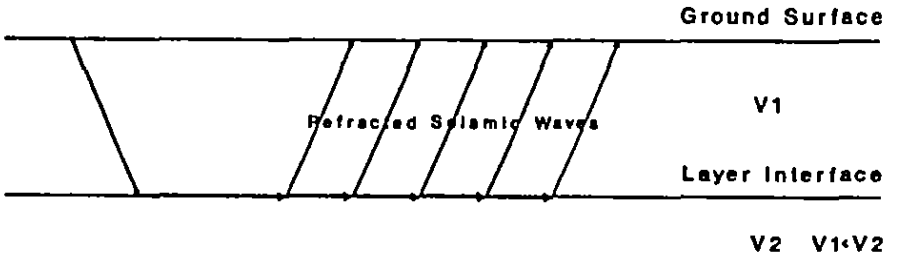
The sands in the shallow (<0.080 sec) range are believed to be discontinuous (lenses). The continuity of the sands, apart from lensing, is rather good, however, suggesting that there is not a lot of faulting on site.

There is one potential fault as defined by disruptions seen near Station 120 on Line 100 and Station 140 on Line 400. Tying these two features together in plan view (figure 14) shows that if they are indeed the same fault, then this fault has a nearly EW strike (agrees with expected regional geology) and dips to the NW (i.e. an up to the coast fault) which is not the more common type of coastal growth fault but is, nonetheless, typical.

4.0 LIMITATIONS

The geophysical assessment of the seismic data at this site is based upon our professional evaluation of the geophysical data gathered and our experience with seismic refraction and reflection operations and data interpretation for geologic materials as found in this area. The geophysical evaluation rendered in this report meets the standards of care of our profession. No other warranty or representation, either expressed or implied, is included or intended.

FIGURES


Ground Surface
Refracted Seismic Waves
V1
Layer Interface
V2 V1<V2

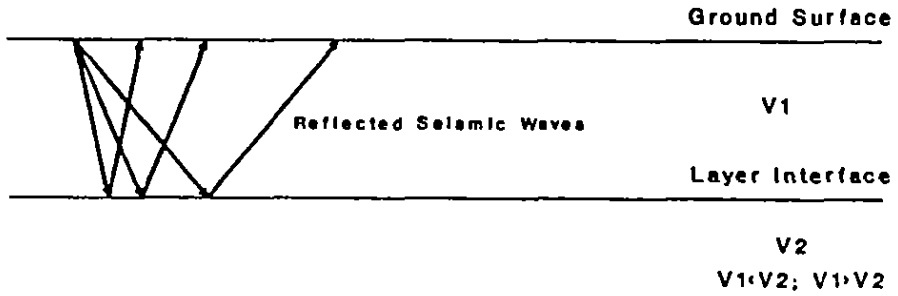

Ground Surface
Reflected Seismic Waves
V1
Layer Interface
V2
V1<V2; V1>V2

FIGURE 1

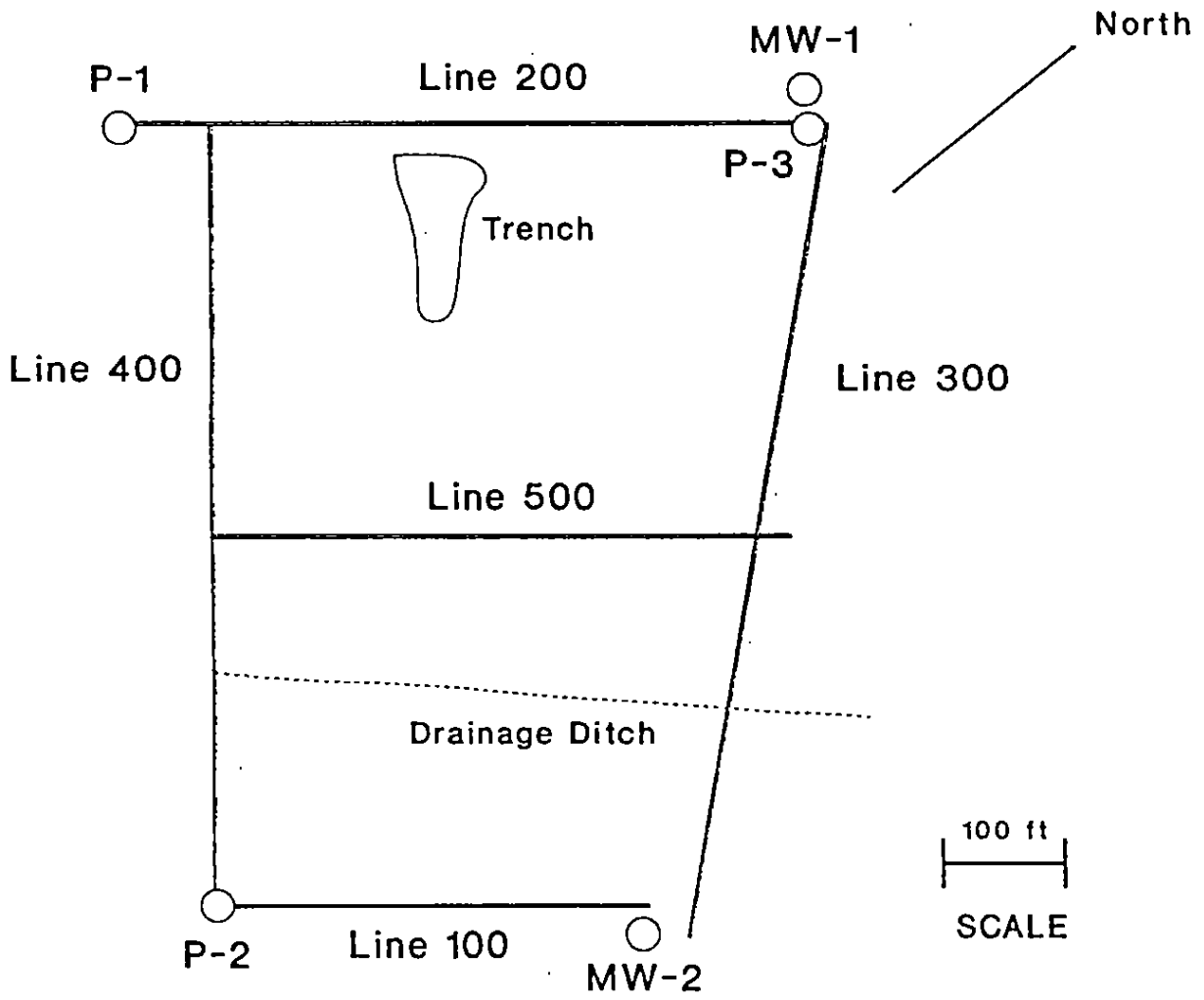

MW-1
North
P-1
Line 200
P-3
Trench
Line 400
Line 300
Line 500
Drainage Ditch
100 ft
SCALE
P-2
Line 100
MW-2

FIGURE 2

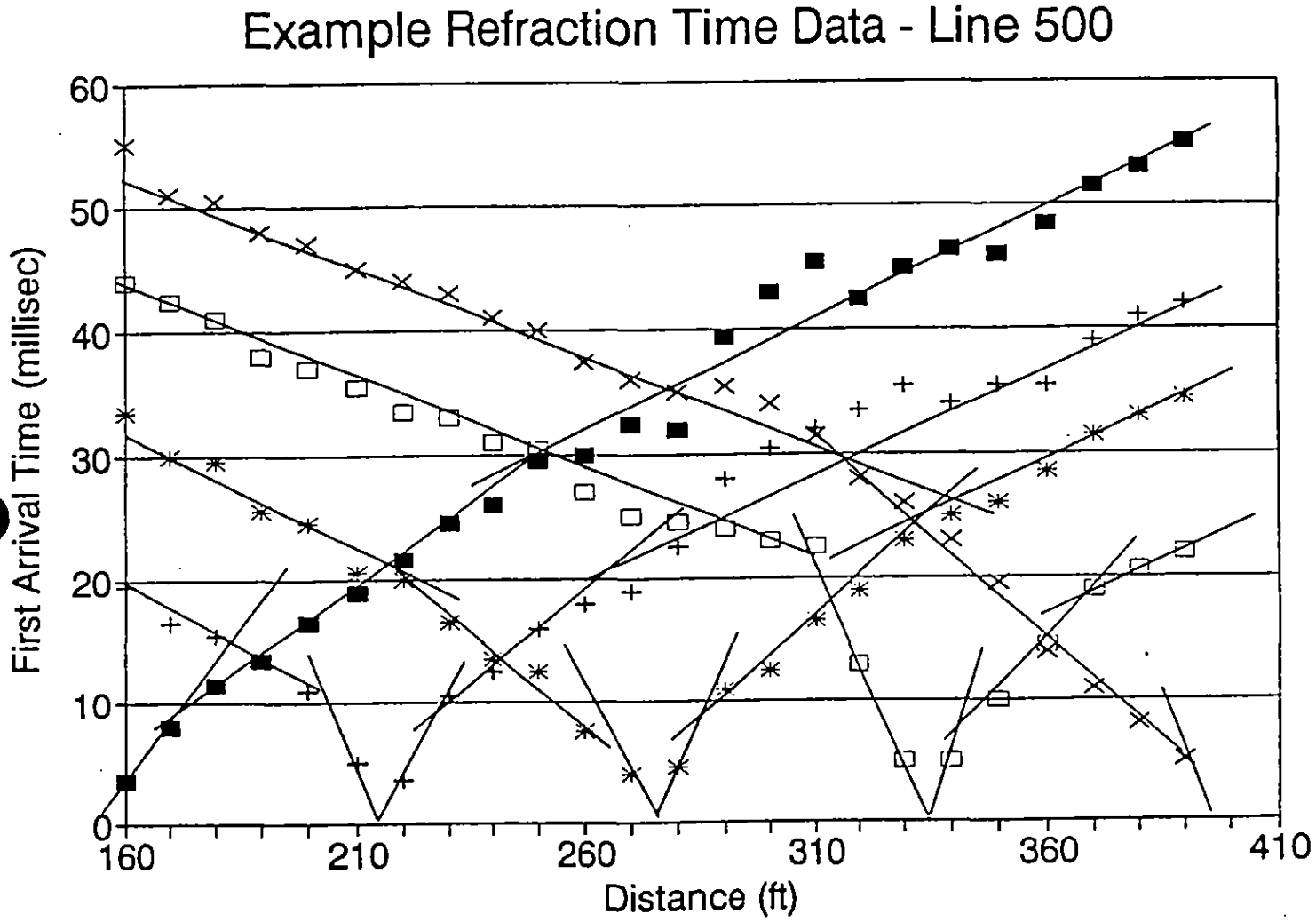

Example Refraction Time Data - Line 500
First Arrival Time (millisec)
60
50
40
30
20
10
0
160
210
260
310
360
410
Distance (ft)

FIGURE 3

Laidlaw Environmental Services
Colfax Site - Line 200

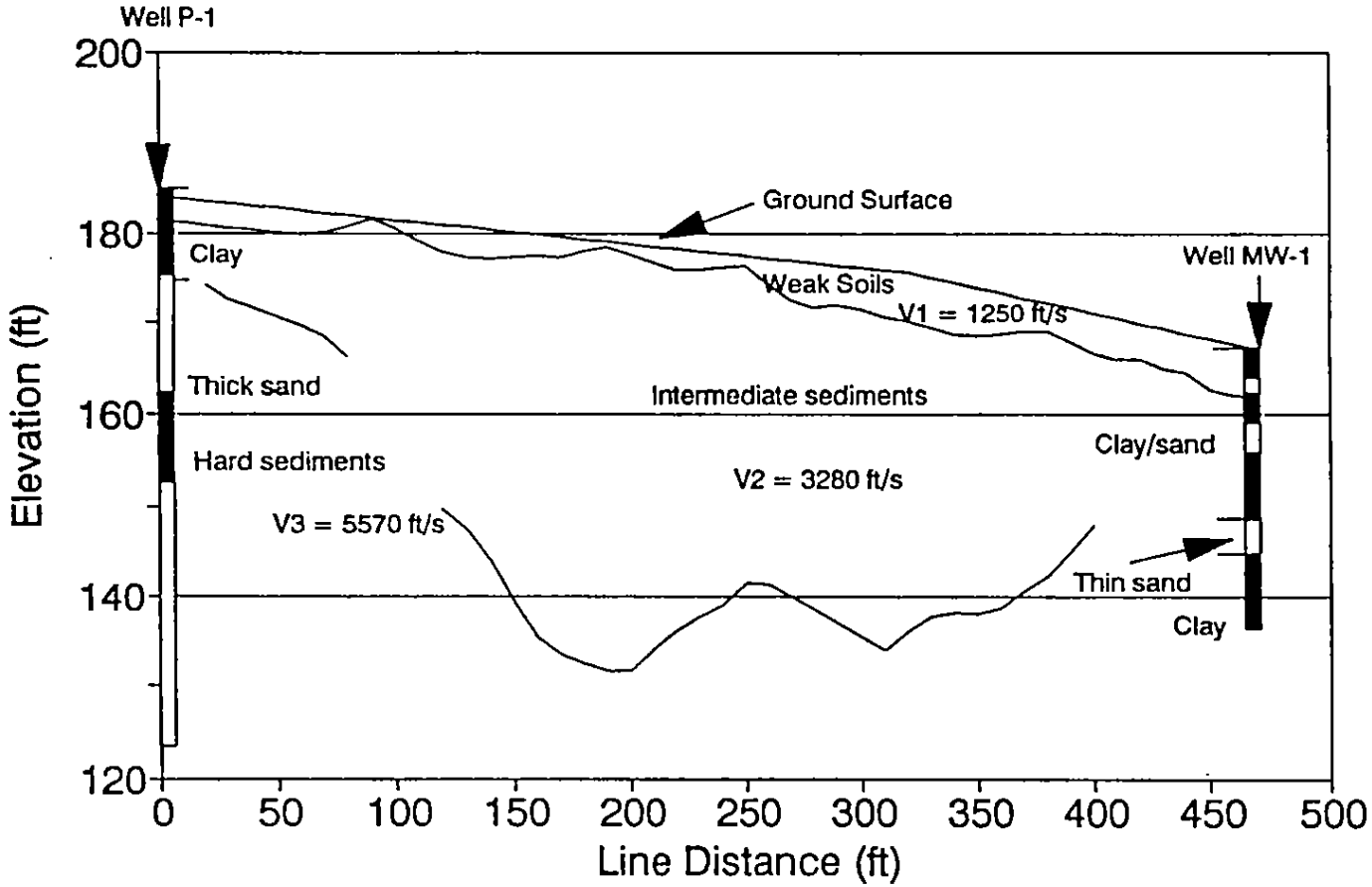


FIGURE 5

Laidlaw Environmental Services
Colfax Site - Line 300

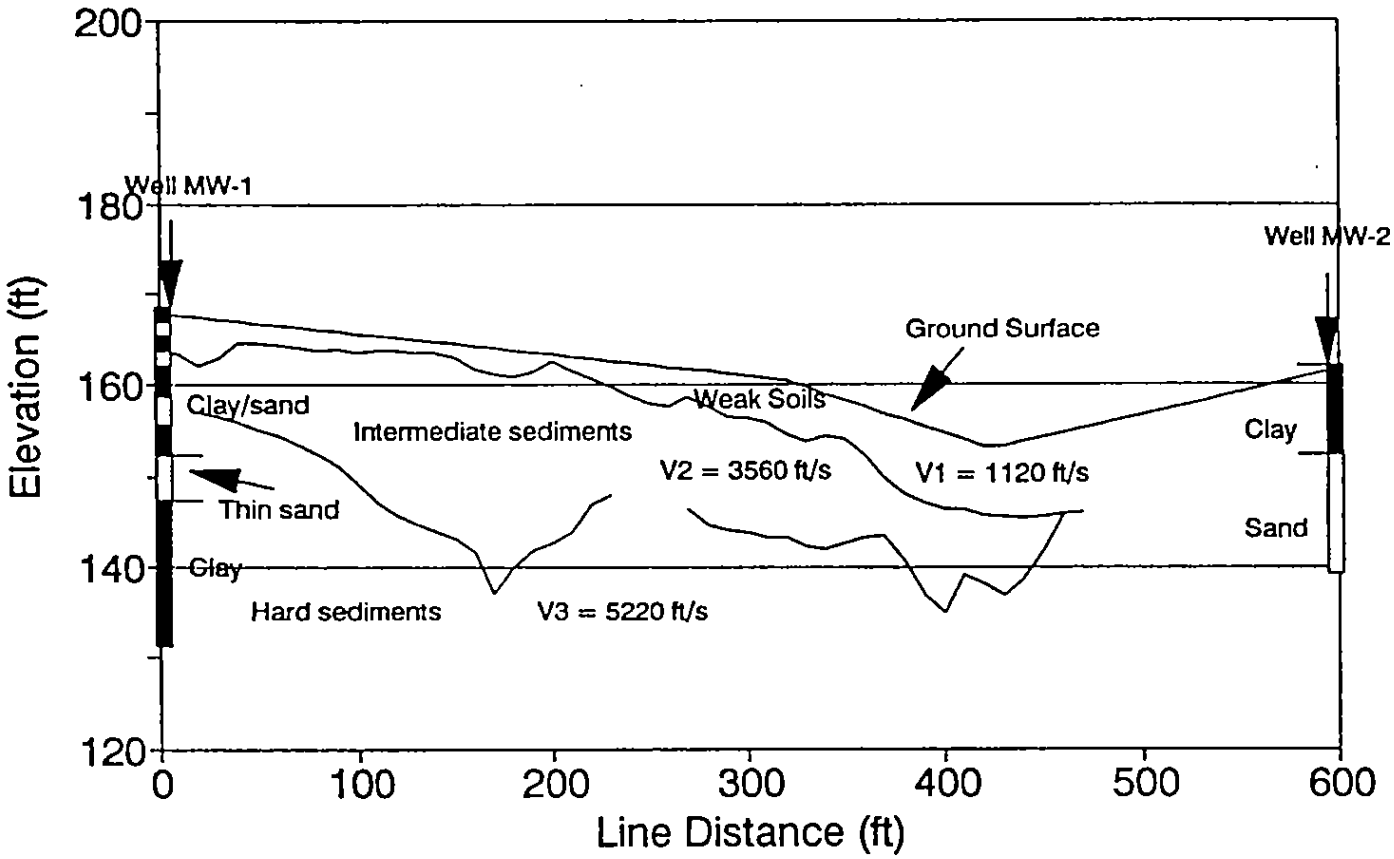


FIGURE 6

Laidlaw Environmental Services
Colfax Site - Line 400

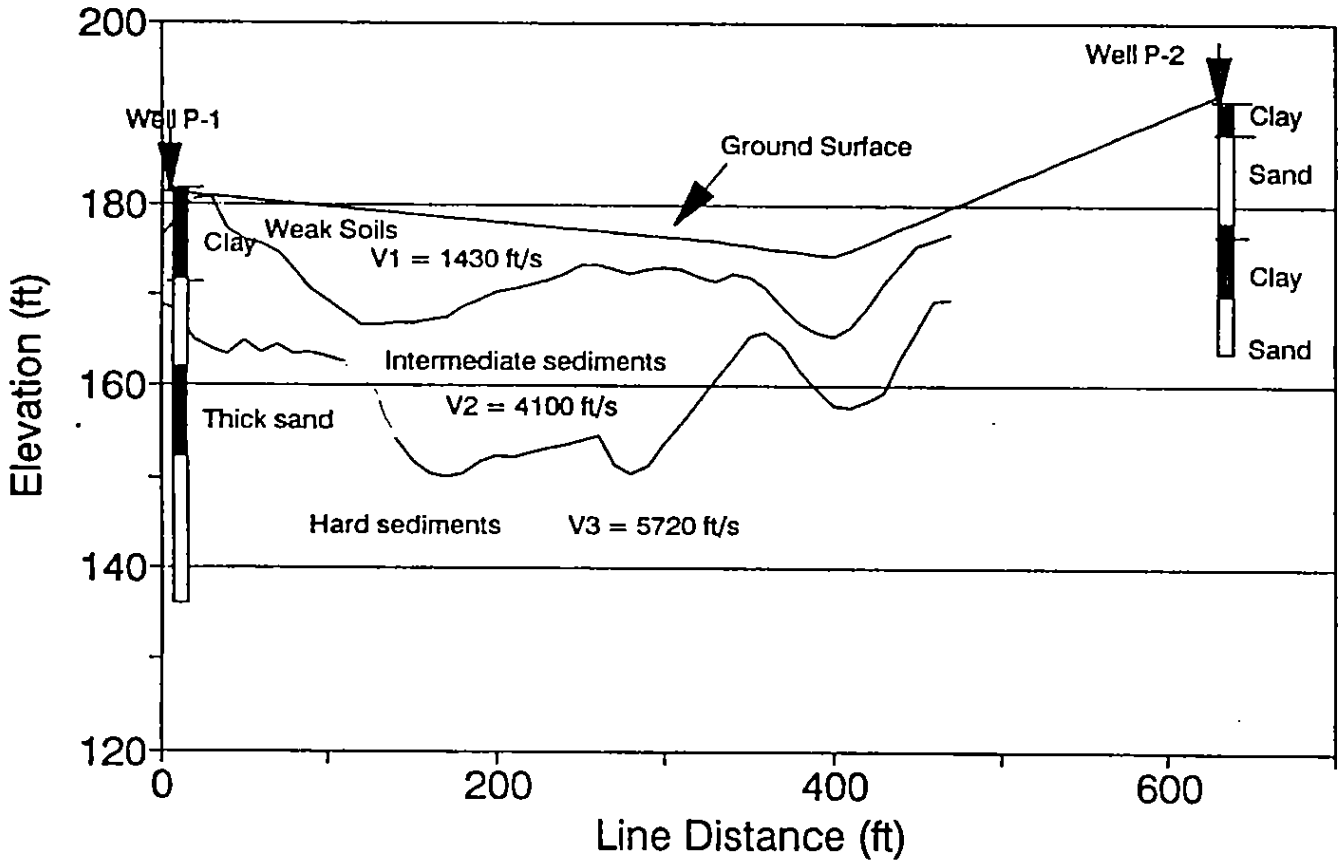


FIGURE 7

Laidlaw Environmental Services
Colfax Site - Line 500

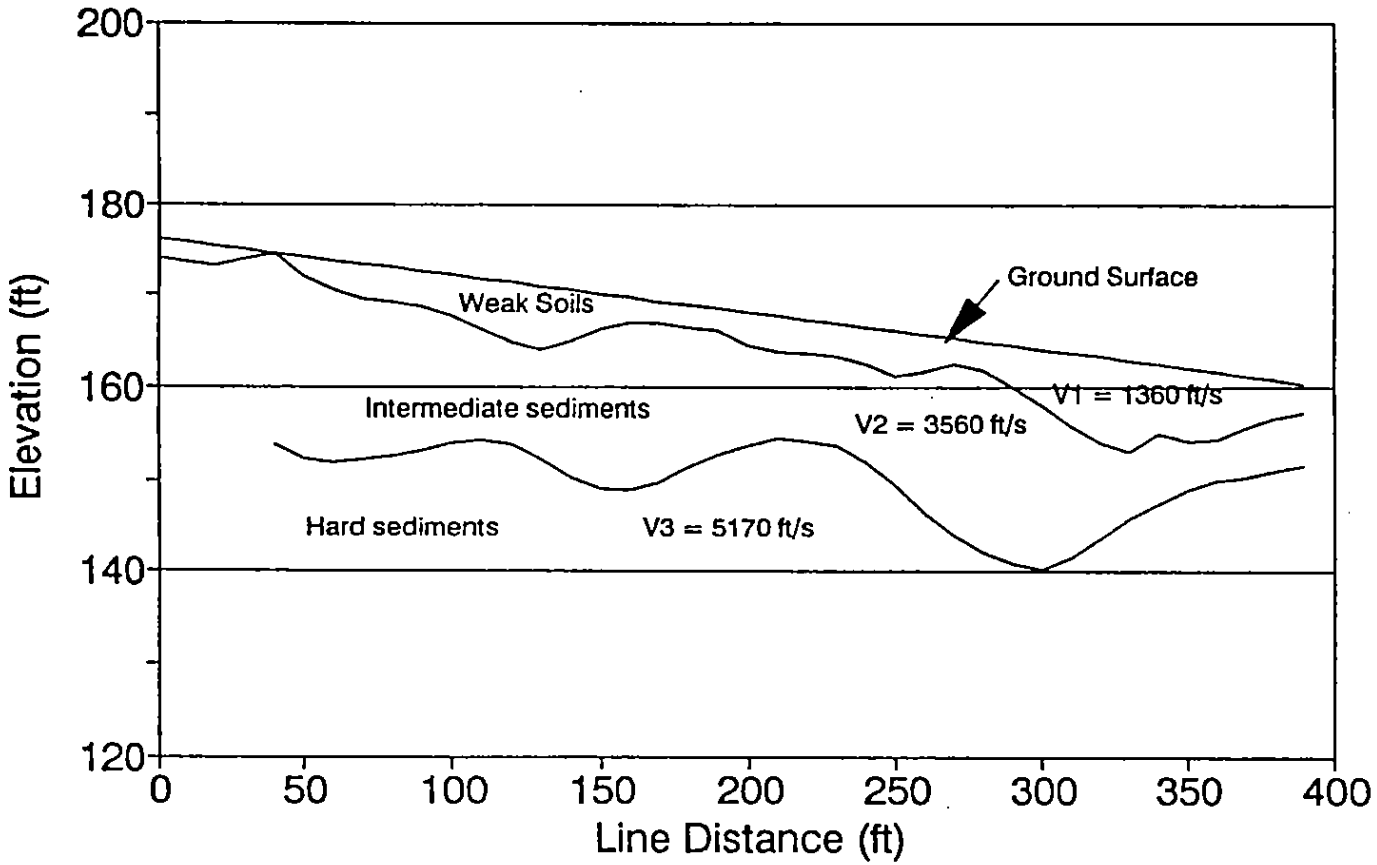


FIGURE 8

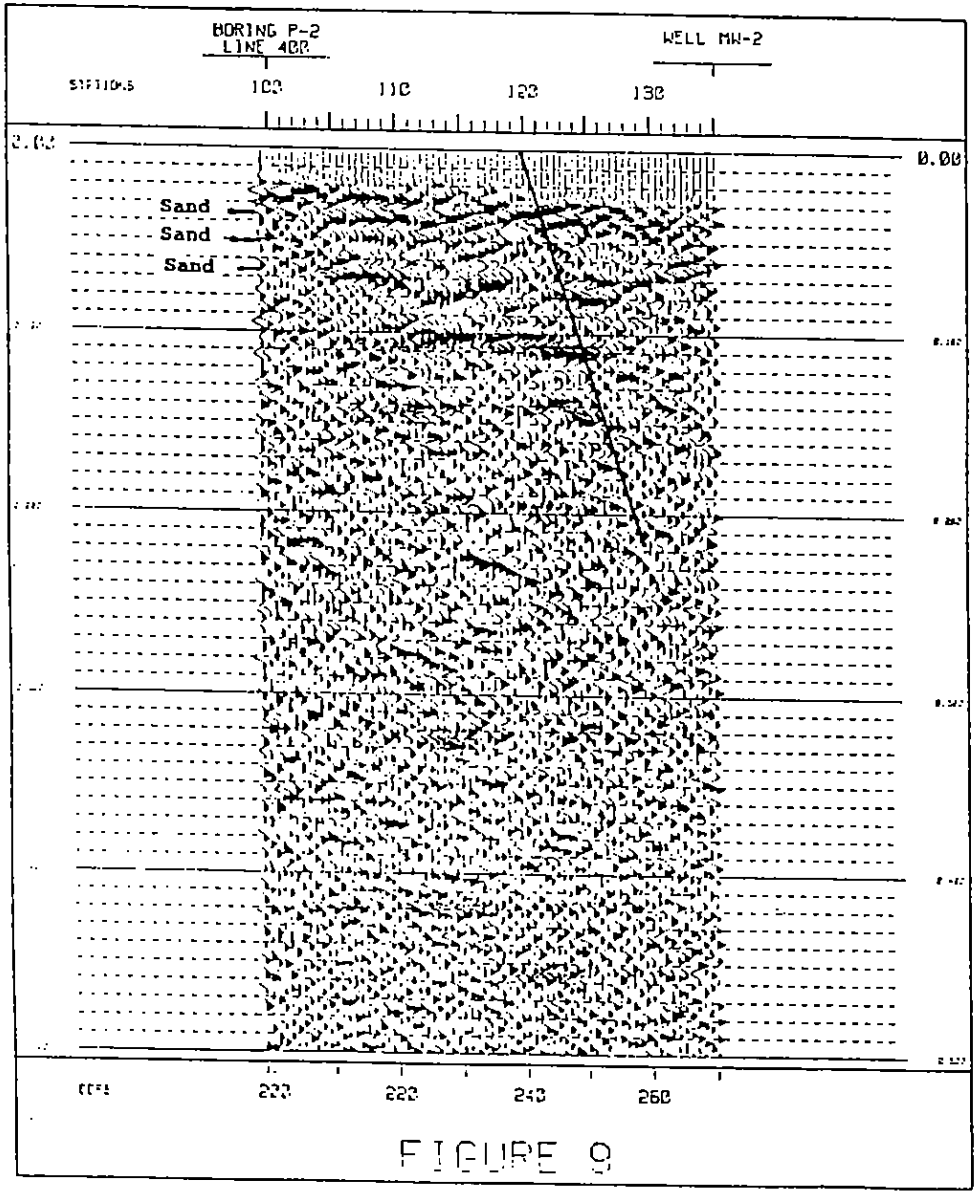


FIGURE 9

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 100

SP: 99 - 135
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL

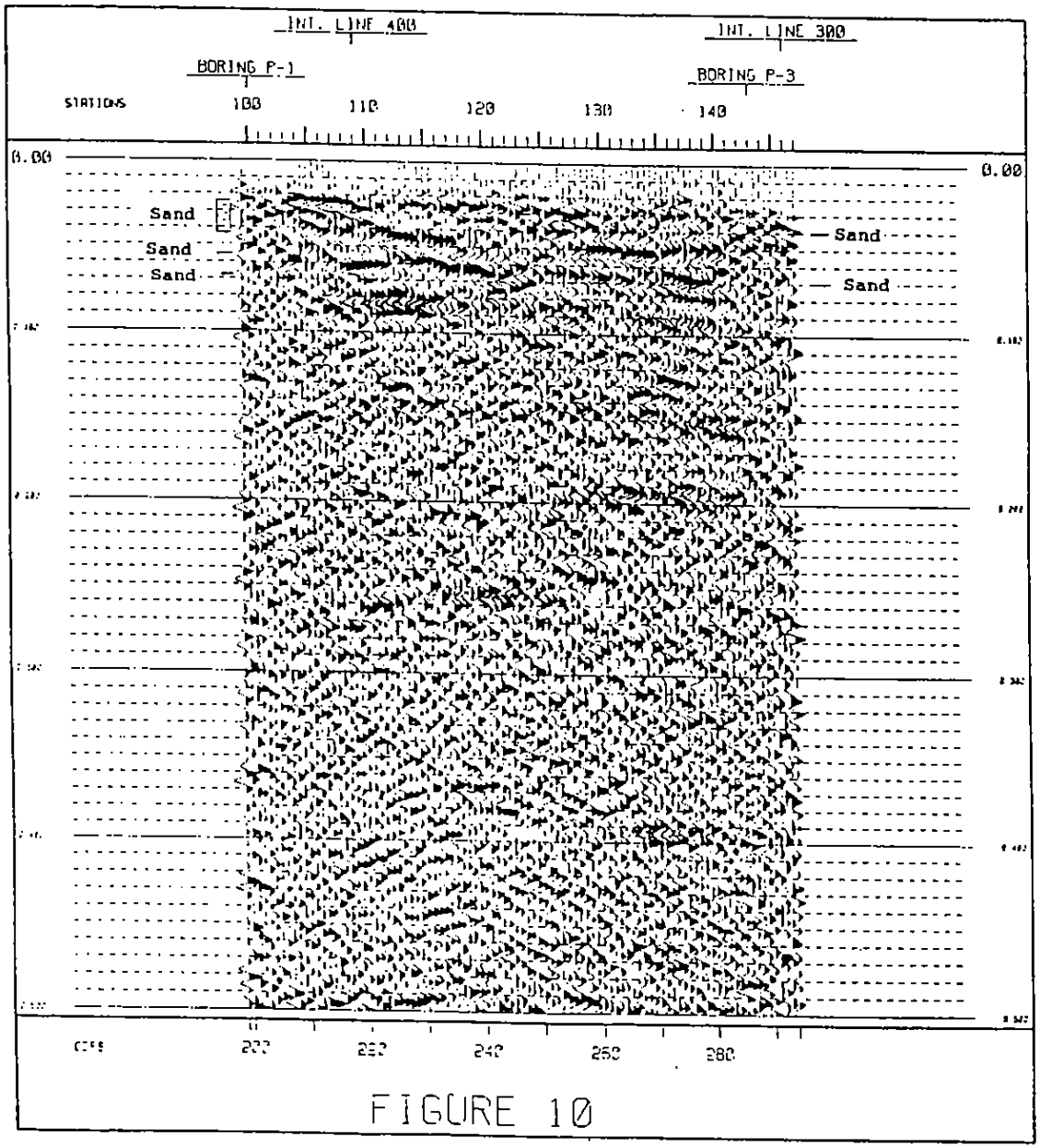


FIGURE 10

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 200

SP: 99 - 147
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

DATE	:	JULY 21, 1993
ENERGY SOURCE	:	HAMMER ON STEEL PLATE
PATTERN	:	SINGLE HOLE
DEPTH	:	1 FT.
SP INTERVAL	:	20 FT.
CABLE	:	24 CHANNELS
GEOPHONE TYPE	:	40 HZ VERTICAL
GROUP INTERVAL	:	10 FT.
PATTERN	:	INLINE
RECORDING INSTRUMENTS	:	[illegible]
FORMAT	:	[illegible]
SAMPLE RATE	:	.5 MSEC
RECORD LENGTH	:	512 MSEC
FILTER	:	OUT/OUT HZ
NOTCH	:	OUT
SHOT-CABLE CONFIG.	:	

SP
V 1 24
5 FT OFFSET ..... 235 FT.

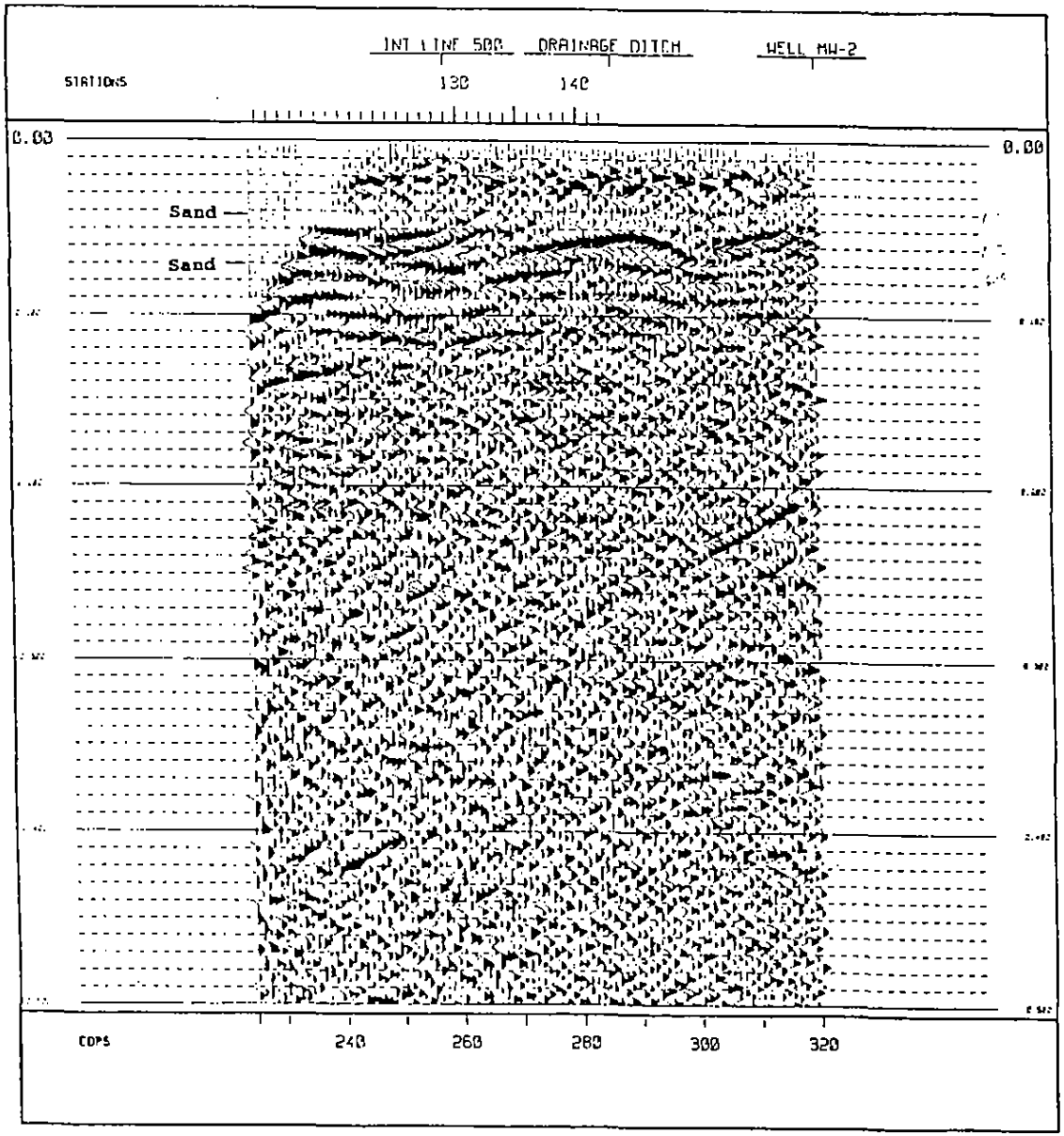
PROCESSING PARAMETERS

1 REFORMAT BEG-Y TO INTERNAL FORMAT
2 DATUM STATICS
TYPE : SURFACE TO 100 FT.
CORRECTION VELOCITY 3000 FT/S
3 DECONVOLUTION
TYPE : SPIKING
PHASE : MINIMUM
OPERATOR : 161 POINTS
4 COMMON DEPTH POINT SORT
5 FIRST VELOCITY ANALYSIS
6 NMO
7 MUTE
8 AGC 100 MS
9 STACK 1200%
10 SIGNAL ENHANCEMENT
11 BANDPASS FILTER:

TIME	HZ	DB/OCT	HZ	DB/OCT
0 - 500	30	18	150	72

12 AGC 50 MS
13 DISPLAY

GEOSIGNAL



LAIDLAW ENVIRONMENTAL SERVICES

SOUTHEAST

LINE 300

SP: 125 - 161
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

DATE	:	JULY 21, 1990
ENERGY SOURCE	:	HAMMER ON STEEL PLATE
PATTERN	:	SINGLE HOLE
DEPTH	:	1 FT.
SP INTERVAL	:	20 FT.
CABLE	:	24 CHANNELS
GEOPHONE TYPE	:	40 HZ VERTICAL
GROUP INTERVAL	:	10 FT.
PATTERN	:	INLINE
RECORDING INSTRUMENTS	:	ESQ-01
FORMAT	:	ESTH
SAMPLE RATE	:	.5 MSEC
RECORD LENGTH	:	512 MSEC
FILTER	:	OUT/OUT HZ
NOTCH	:	OUT
SHOT-CABLE CONFIG.	:	

SP
V 1 24
20 FT OFFSET ..... 250 FT.

PROCESSING PARAMETERS

1 REFORMAT SEG-Y TO INTERNAL FORMAT
2 DATUM STATICS
TYPE : SURFACE TO 180 FT.
CORRECTION VELOCITY 3000 FT/S
3 DECONVOLUTION:
TYPE : SPIKING
PHASE : MINIMUM
OPERATOR : 161 POINTS
4 COMMON DEPTH POINT SORT
5 FIRST VELOCITY ANALYSIS
6 NMO
7 MUTE
8 AGC 100 MS
9 STACK 1200%
10 SIGNAL ENHANCEMENT
11 BANDPASS FILTER:
TIME HZ OB/OCT HZ OB/OCT
0 - 300 30 18 150 72
12 AGC 50 MS
13 DISPLAY

GEOSIGNAL

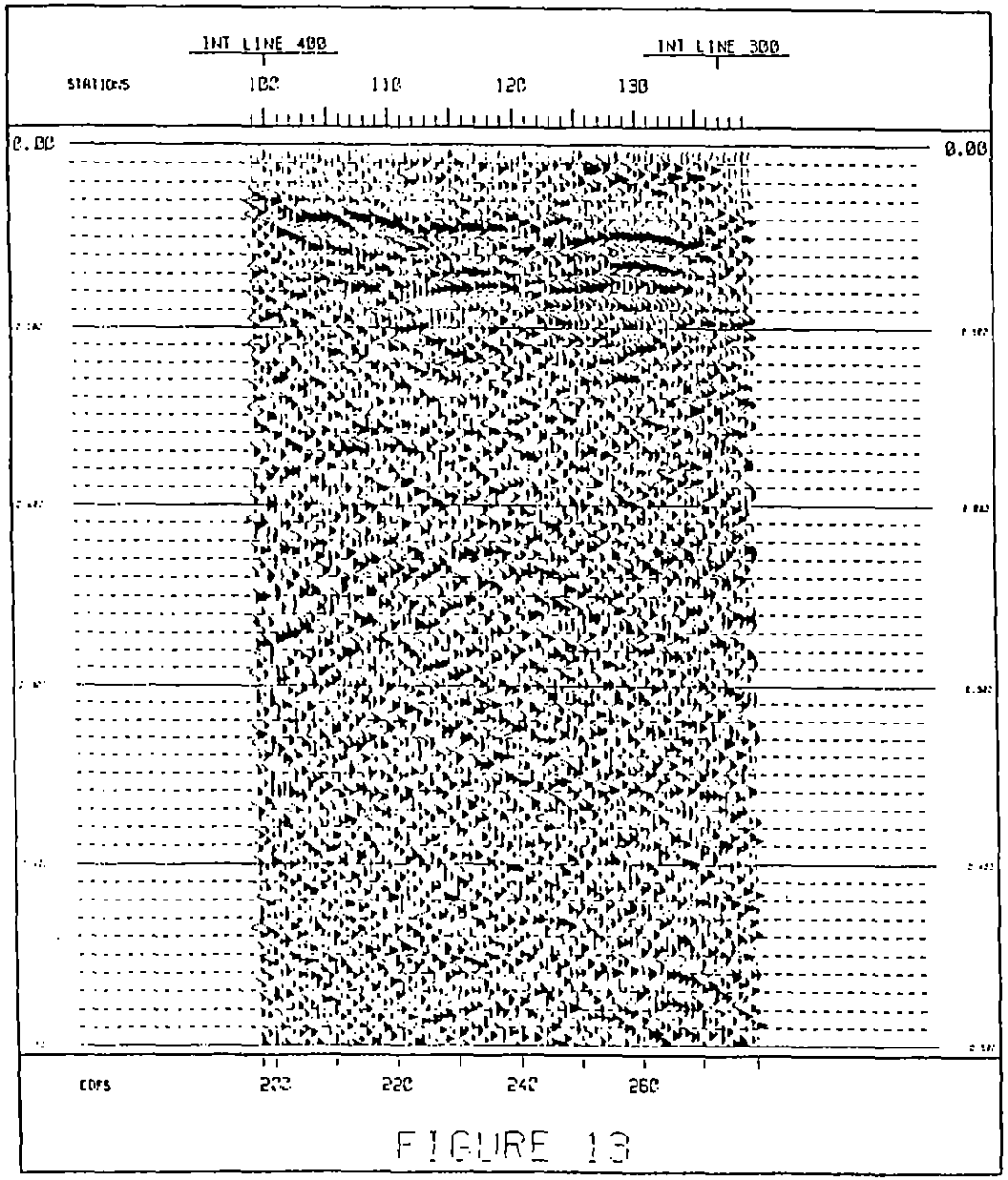


FIGURE 13

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 500

SP: 98 - 140
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL

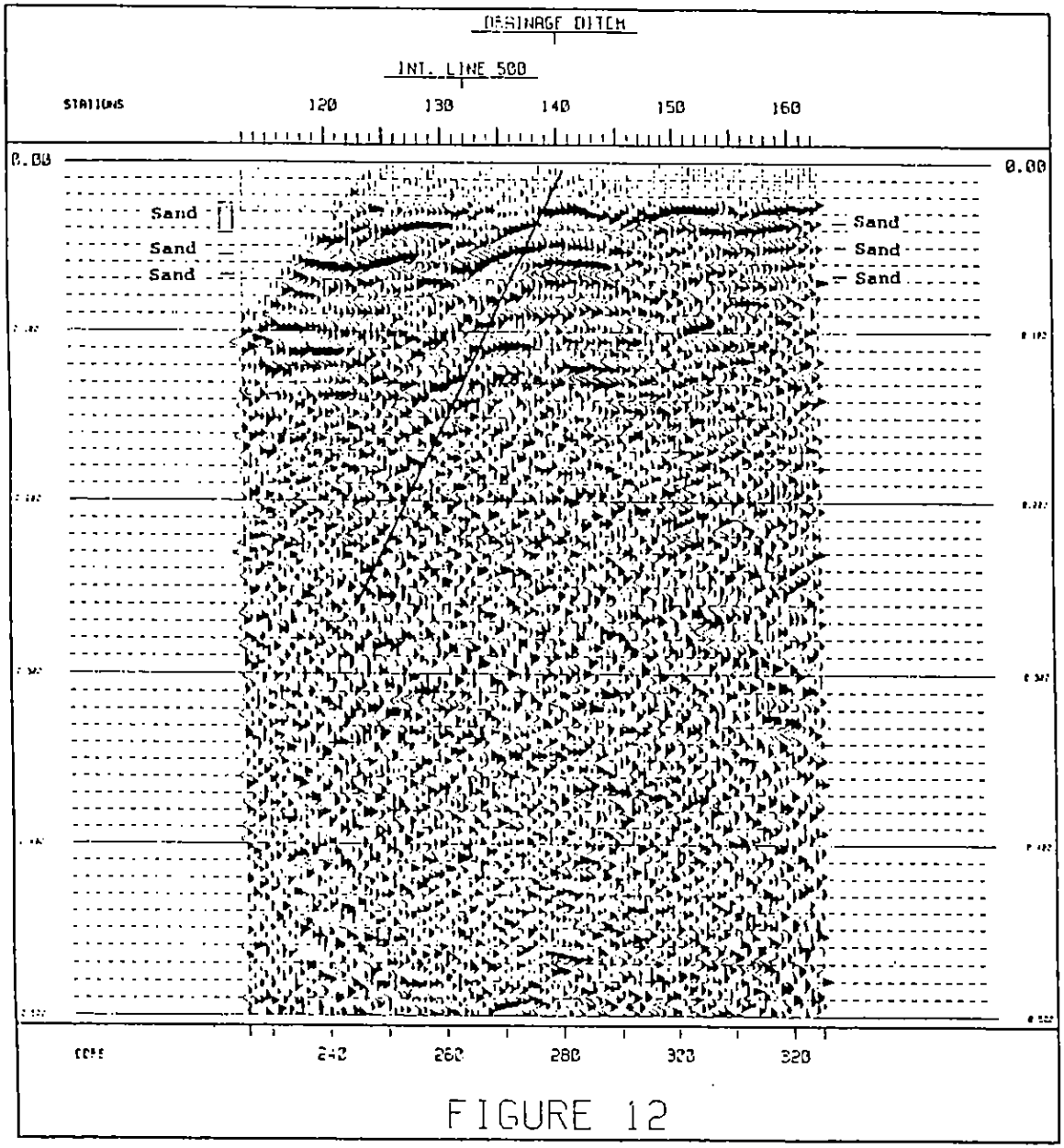


FIGURE 12

LAIDLAW ENVIRONMENTAL SERVICES

SOUTHEAST

LINE 400

SP: 126 - 160
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL

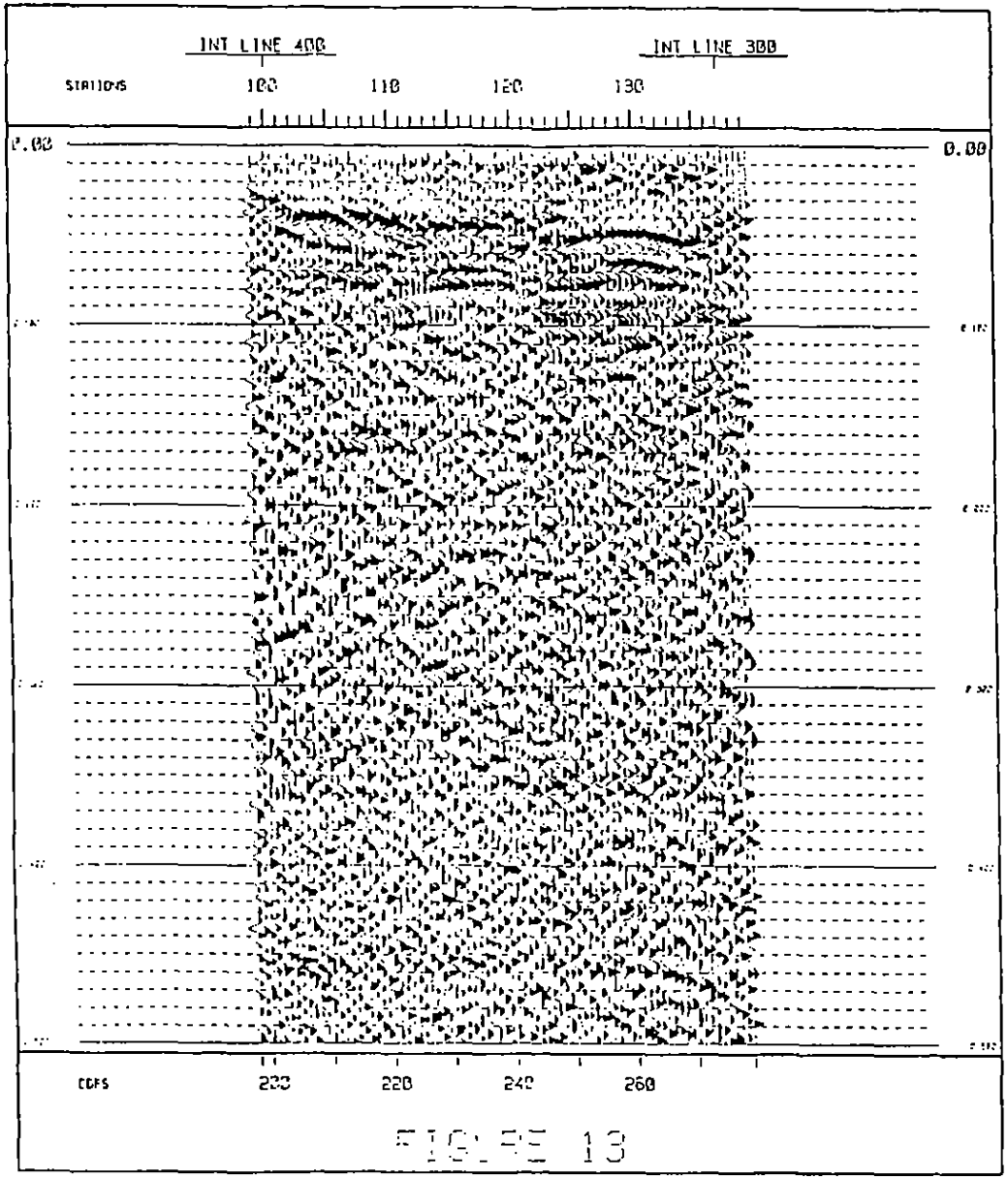


FIGURE 13

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 500

SP: 98 - 140
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

DATE	:	JULY 21, 1988
ENERGY SOURCE	:	HAMMER ON STEEL PLATE
PATTERN	:	SINGLE HOLE
DEPTH	:	1 FT.
SP INTERVAL	:	30 FT.
CABLE	:	24 CHANNELS
GEOPHONE TYPE	:	40 HZ VERTICAL
GROUP INTERVAL	:	10 FT.
PATTERN	:	INLINE
RECORDING INSTRUMENTS	:	[illegible]
FORMAT	:	[illegible]
SAMPLE RATE	:	[illegible]
RECORD LENGTH	:	[illegible]
FILTER	:	[illegible]
NOTCH	:	OUT
SHOT-CABLE CONFIG.	:	

SP
V 1 24
30 FT OFFSET ..... 250 FT.

PROCESSING PARAMETERS

1 REFORMAT SEG-Y TO INTERNAL FORMAT
2 DATUM STATICS
TYPE : SURFACE TO 100 FT
CORRECTION VELOCITY 5000 FT/S
3 DECONVOLUTION
TYPE : SPIKING
PHASE : MINIMUM
OPERATOR : 161 POINTS
4 COMMON DEPTH POINT SORT
5 FIRST VELOCITY ANALYSIS
6 NMO
7 MUTE
8 AGC 100 MS
9 STACK 1200%
10 SIGNAL ENHANCEMENT
11 BANDPASS FILTER:

TYPE	HZ	DB/OCT	HZ	DB/OCT
0 - 300	30	18	150	72

12 AGC 50 MS
13 DISPLAY

GEOSIGNAL

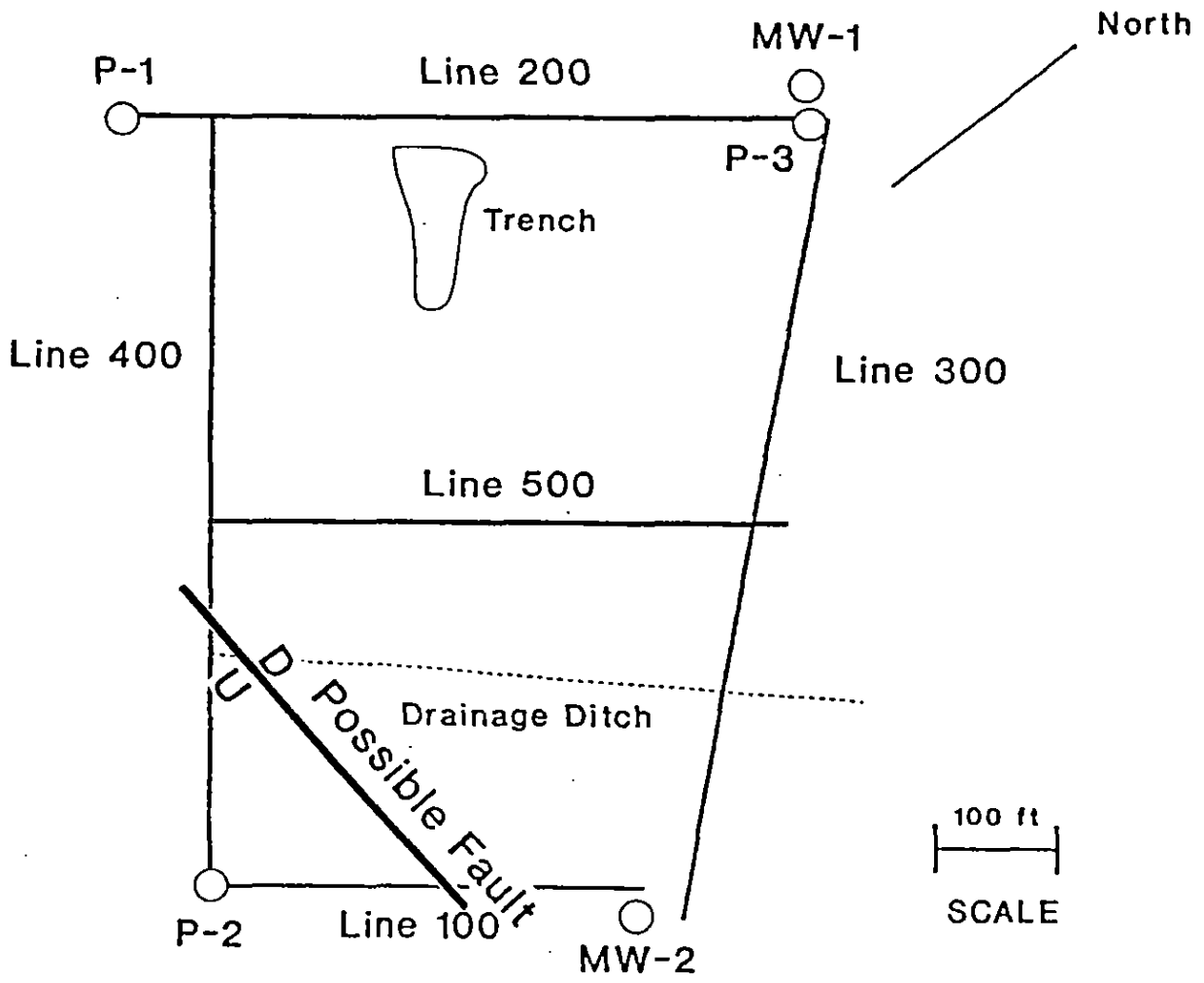

MW-1
North
P-1
Line 200
P-3
Trench
Line 400
Line 300
Line 500
U
D
Possible Fault
Drainage Ditch
100 ft
SCALE
P-2
Line 100
MW-2

FIGURE 14

APPENDIX A - Raw (uninterpreted) seismic reflection sections

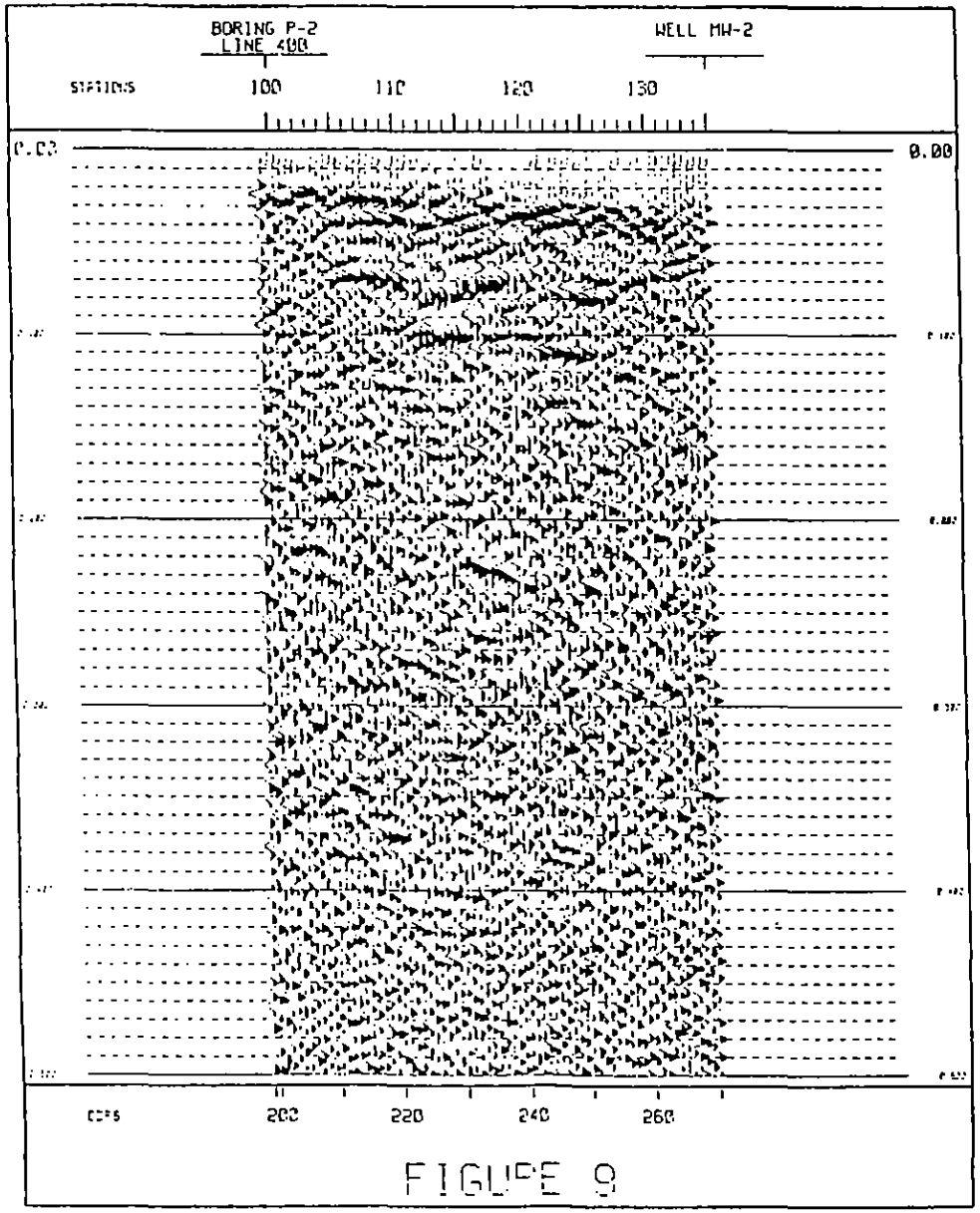


FIGURE 9

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 100

SP: 99 - 135
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL

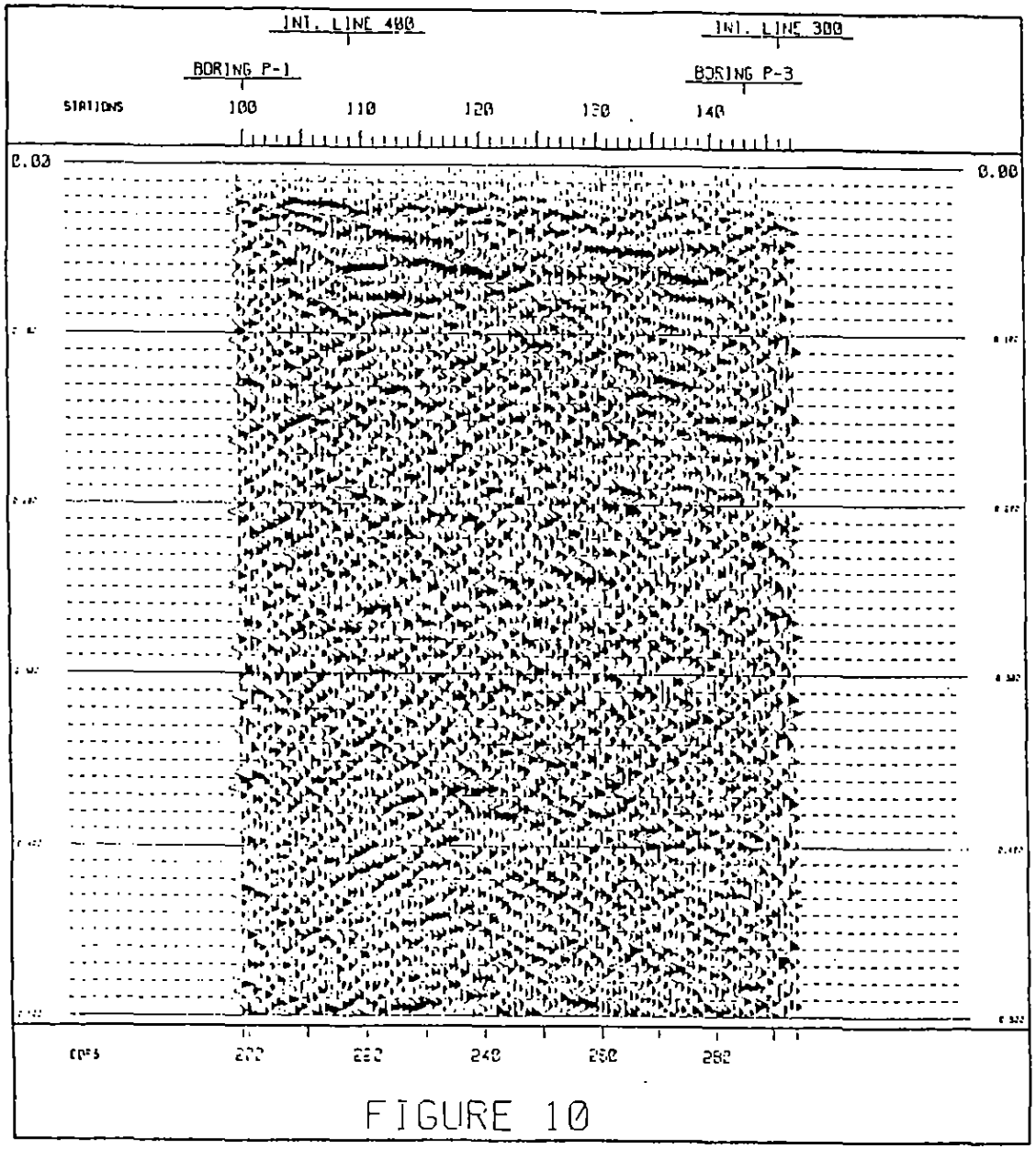


FIGURE 10

LAIDLAW ENVIRONMENTAL SERVICES

NORTHEAST

LINE 200

SP: 99 - 147
TRACE SPACING IS 5 FT.

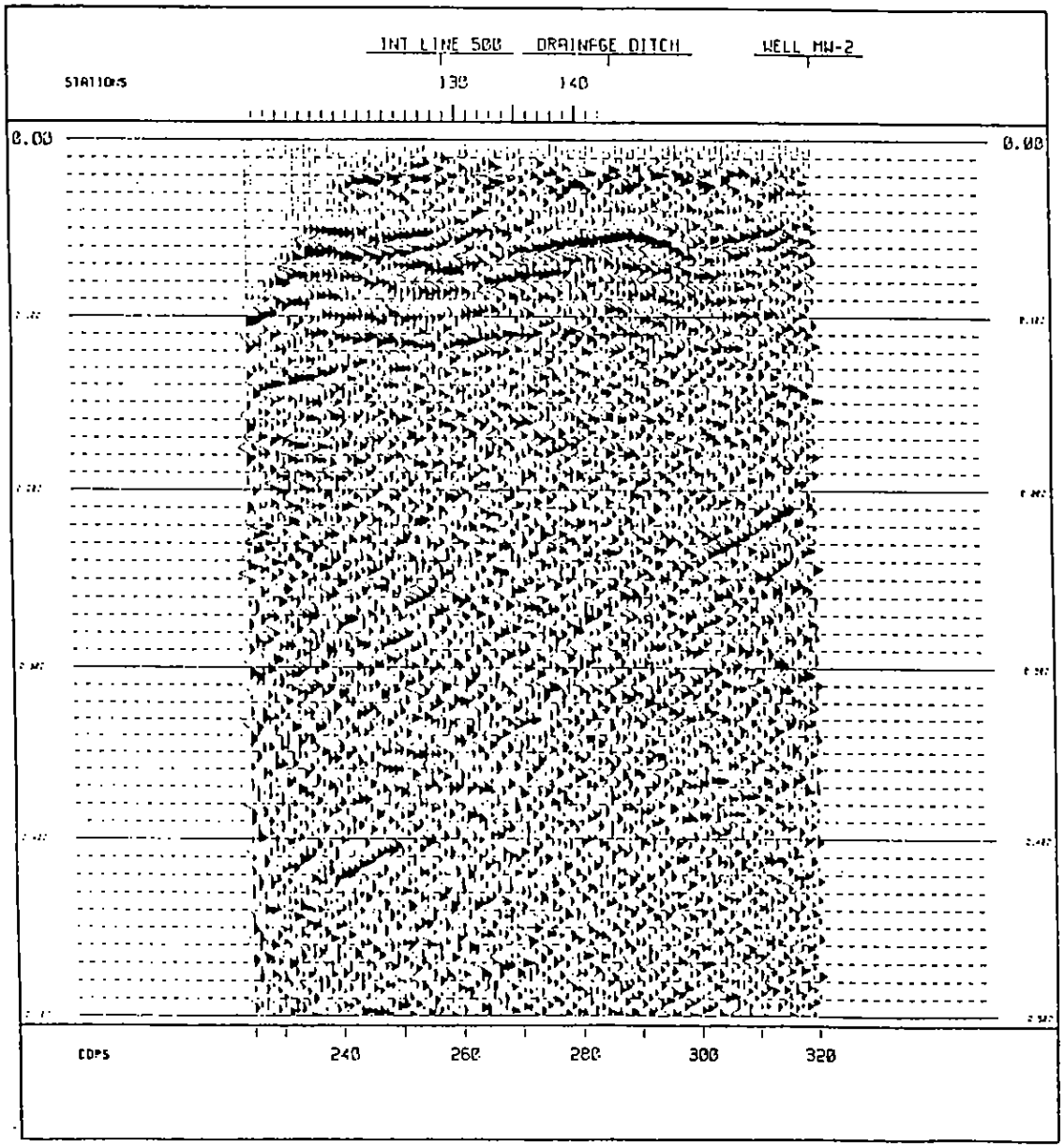
AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL



LAIDLAW ENVIRONMENTAL SERVICES

SOUTHEAST

LINE 300

SP: 125 - 161

TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

DATE	JULY 21, 1993
ENERGY SOURCE	
PATTERN	
DEPTH	
SP INTERVAL	
CABLE	
RECEIVER TYPE	
GROUP INTERVAL	
PATTERN	
RECORDING INSTRUMENTS	
SAMPLE RATE	
RECORD LENGTH	
FILTERS	
FORMAT	
SHOT-CABLE CONFIG.	

PROCESSING PARAMETERS

1. REFORMAT SEG-Y TO INTERNAL FORMAT
2. DATUM STATICS
   TYPE : REFRACTOR TO SEA LEVEL
   REPLACEMENT VELOCITY 3000 FT/S
3. DECONVOLUTION
   TYPE : SPIKING
   GATE : ENTIRE
   OPERATOR : 161 POINTS
4. CDP/CMP: DEPTH POINT SORT
5. FIRST VELOCITY ANALYSIS
6. NMO
7. MUTE
8. AGC 180 MS
9. STACK 1200%
10. SIGNAL ENHANCEMENT
11. BANDPASS FILTER:
    TYPE | HZ | DB/OCT | HZ | DB/OCT
    0 - 3000 | 5 | 18 | 150 | 36
12. AGC 50 MS
13. DISPLAY

GEOSIGNAL

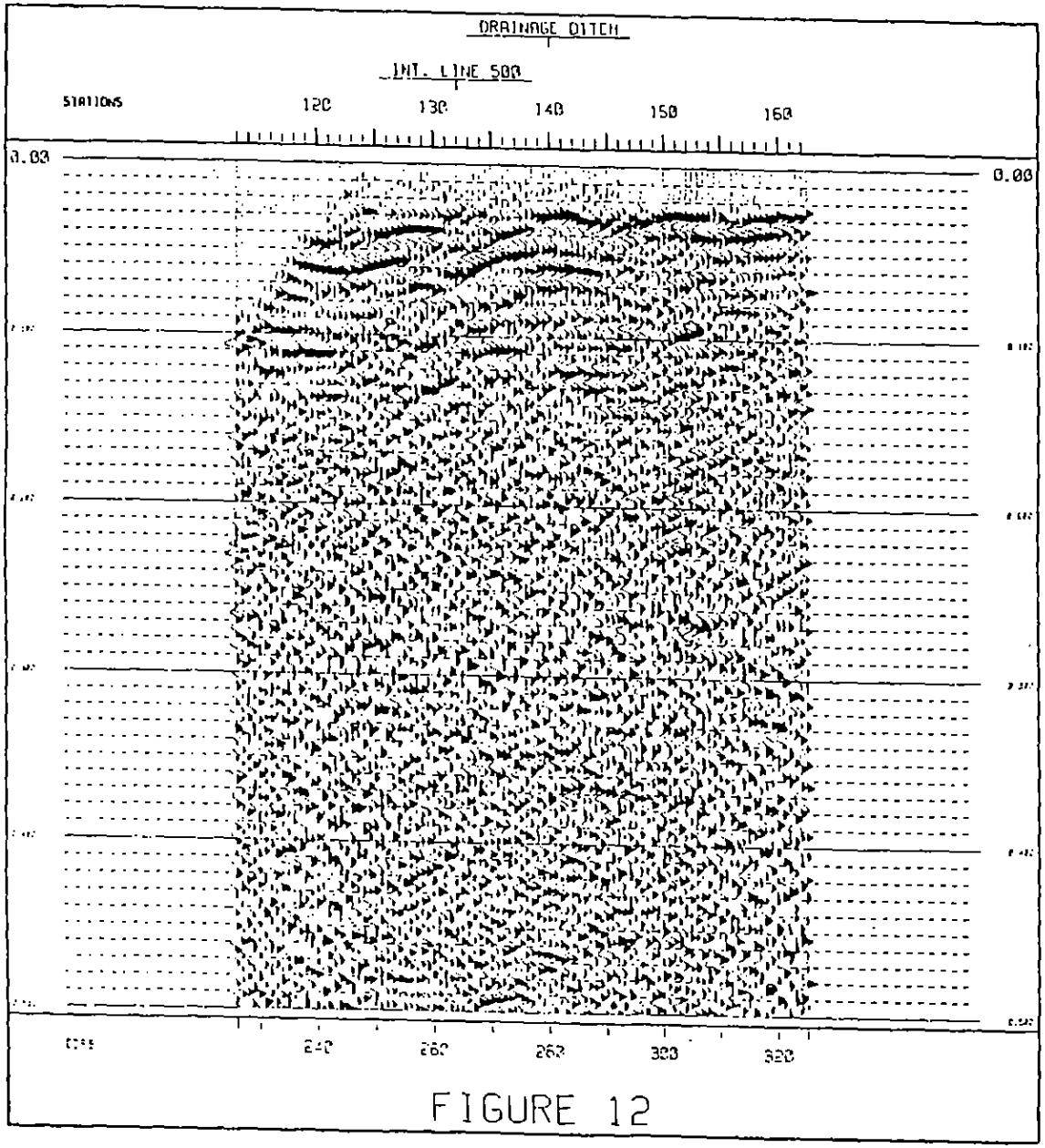


FIGURE 12

LAIDLAW ENVIRONMENTAL SERVICES

SOUTHEAST

LINE 400

SP: 126 - 160
TRACE SPACING IS 5 FT.

AREA: COLFAX R&D FACILITY

ACQUIRED BY:
SUBSURFACE DETECTION

RECORDING PARAMETERS

PROCESSING PARAMETERS

GEOSIGNAL

APPENDIX 2-G

LABORATORY QUALITY CONTROL DOCUMENTATION

QUALITY CONTROL DOCUMENTATION

SOIL VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306215 SAS No.: _____ SDG No.: 306215

Level: (low/med) LOW

	EPA SAMPLE NO.	SMC1 (TOL) #	SMC2 (BFB) #	SMC3 (DCE) #	OTHER	TOT OUT
01	S-1_6_	109	88	100	0	0
02	SP-1_6_	109	91	98	0	0
03	VSBLK01	117	84	98	0	0

	QC LIMITS
SMC1 (TOL) = Toluene-d8	(84-138)
SMC2 (BFB) = Bromofluorobenzene	(59-113)
SMC3 (DCE) = 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306110 SAS No.: _____ SDG No.: 306215

Matrix Spike - EPA Sample No.: AOC2-COMP Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	250.0	0	248.5	99	59-172
Trichloroethene	250.0	0	230.5	92	62-137
Benzene	250.0	0	230.0	92	66-142
Toluene	250.0	0	243.5	97	59-139
Chlorobenzene	250.0	0	233.5	93	60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	250.0	254.5	102	3	22	59-172
Trichloroethene	250.0	224.0	90	2	24	62-137
Benzene	250.0	234.5	94	2	21	66-142
Toluene	250.0	271.5	109	12	21	59-139
Chlorobenzene	250.0	232.0	93	0	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: 8240S,306110,,AOC2-COMP,L,S,9306110-12A,V,E,X5,
PACK,0609VS2A4,0609BFA2,0609VSBA1,,,,45/3-220@8,INST A,

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VSBLK01

b Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306215 SAS No.: _____ SDG No.: 306215

Lab File ID: 0609VSBA1 Lab Sample ID: VSBLK010609A

Date Analyzed: 06/09/93 Time Analyzed: 1508

GC Column: PACK ID: _____(mm) Heated Purge: (Y/N) Y

Instrument ID: A

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	S-1_6_	9306215-01B	V621501	1739
02	SP-1_6_	9306215-02B	V621502	1816

COMMENTS: SPL,BLANK,,VSBLK01,L,S,VSBLK010609A,V,B,5MLS,
PACK,0609VS2A4,0609BFA2,,,,,45/3-220@8,INST A,

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010609
Batch: VOA930609133700

Reported on: 06/11/93 14:
Analyzed on: 06/09/93 15:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
1,1,1-Trichloroethane	ND	5	µg/Kg
1,1,2,2-Tetrachloroethane	ND	5	µg/Kg
1,1,2-Trichloroethane	ND	5	µg/Kg
1,1-Dichloroethene	ND	5	µg/Kg
1,1-Dichloroethane	ND	5	µg/Kg
1,2-Dichloroethane	ND	5	µg/Kg
1,2-Dichloropropane	ND	5	µg/Kg
2-Butanone	ND	20	µg/Kg
2-Chloroethylvinylether	ND	10	µg/Kg
2-Hexanone	ND	10	µg/Kg
4-Methyl-2-Pentanone	ND	10	µg/Kg
Acetone	ND	10	µg/Kg
Benzene	ND	5	µg/Kg
Bromodichloromethane	ND	5	µg/Kg
Bromoform	ND	5	µg/Kg
Bromomethane	ND	10	µg/Kg
Carbon Disulfide	ND	5	µg/Kg
Carbon Tetrachloride	ND	5	µg/Kg
Chloromethane	ND	10	µg/Kg
Chloroethane	ND	10	µg/Kg
Chloroform	ND	5	µg/Kg
Chlorobenzene	ND	5	µg/Kg
Dibromochloromethane	ND	5	µg/Kg
Ethylbenzene	ND	5	µg/Kg
Methylene Chloride	ND	5	µg/Kg
Styrene	ND	5	µg/Kg
Tetrachloroethene	ND	5	µg/Kg
Toluene	ND	5	µg/Kg
Trichlorofluoromethane	ND	5	µg/Kg
Trichloroethene	ND	5	µg/Kg
Vinyl Chloride	ND	10	µg/Kg
Vinyl Acetate	ND	10	µg/Kg
Xylene (total)	ND	5	µg/Kg
cis-1,3-Dichloropropene	ND	5	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report page

Matrix: Soil
Sample ID: VSBLK010609
Batch: VOA930609133700

Reported on: 06/11/93 14:
Analyzed on: 06/09/93 15:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
total-1,2-Dichloroethene	ND	5	µg/Kg
trans-1,3-Dichloropropene	ND	5	µg/Kg

Surrogate	Result	QC Criteria	Units
1,2-Dichloroethane-d4	98	70-121	% Recovery
4-Bromofluorobenzene	84	59-113	% Recovery
Toluene-d8	117	84-138	% Recovery

Samples in Batch 9306215-01 9306215-02

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306215 SAS No.: _____ SDG No.: 306215

Level: (low/med) LOW

	EPA SAMPLE NO.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#	S7 (2CP)#	S8 (DCB)#	TOT OUT
01	S-1	73	77	76	69	69	66	75	73	0
02	SP-1	73	76	78	74	69	70	74	73	0
03	SBLK02	84	93	128	79	89	94	77	79	0

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(23-120)	
S2 (FBP)	= 2-Fluorobiphenyl	(30-115)	
S3 (TPH)	= Terphenyl-d14	(18-137)	
S4 (PHL)	= Phenol-d5	(24-113)	
S5 (2FP)	= 2-Fluorophenol	(25-121)	
S6 (TBP)	= 2,4,6-Tribromophenol	(19-122)	
S7 (2CP)	= 2-Chlorophenol-d4	(20-130)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(20-130)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 305896 SAS No.: _____ SDG No.: 306215

Matrix Spike - EPA Sample No.: S-12_EAST Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Phenol	3170	0	1815	57	26- 90
2-Chlorophenol	3170	0	1874	59	25-102
1,4-Dichlorobenzene	2110	0	1241	59	28-104
N-Nitroso-di-n-prop.(1)	2110	0	1030	49	41-126
1,2,4-Trichlorobenzene	2110	0	1326	63	38-107
4-Chloro-3-methylphenol	3170	0	2052	65	26-103
Acenaphthene	2110	0	1359	64	31-137
4-Nitrophenol	3170	0	2237	71	11-114
2,4-Dinitrotoluene	2110	0	1283	61	28- 89
Pentachlorophenol	3170	0	1756	55	17-109
Pyrene	2110	0	1241	59	35-142

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	3170	2026	64	12	35	26- 90
2-Chlorophenol	3170	2187	69	16	50	25-102
1,4-Dichlorobenzene	2110	1418	67	13	27	28-104
N-Nitroso-di-n-prop.(1)	2110	1140	54	10	38	41-126
1,2,4-Trichlorobenzene	2110	1528	72	13	23	38-107
4-Chloro-3-methylphenol	3170	2389	75	14	33	26-103
Acenaphthene	2110	1537	73	13	19	31-137
4-Nitrophenol	3170	2026	64	10	50	11-114
2,4-Dinitrotoluene	2110	1351	64	5	47	28- 89
Pentachlorophenol	3170	1984	63	14	47	17-109
Pyrene	2110	1503	71	18	36	35-142

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: PAHS,305896,,S-12 EAST,L,S,9305896-12A,B,E,30-1,5/28 DE-2UL
CAP,0602S2F1,0602DFF5,,,,,40/4--300@10,INST F

4B

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

SBLK02

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306215 SAS No.: _____ SDG No.: 306215

Lab File ID: 0610SSBKD1 Lab Sample ID: 930610SNB1

Instrument ID: D1 Date Extracted: 06/10/93

Matrix: (soil/water) SOIL Date Analyzed: 06/14/93

Level: (low/med) LOW Time Analyzed: 1956

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	S-1	9306215-01C	E4065	06/16/93
02	SP-1	9306215-02C	E4066	06/16/93

COMMENTS: SPL,BLANK,,SBLK02,L,S,930610SNB1,B,B,0.0-1,06/10 DE-2UL CAP,0614S2D2,0614DFD2,,,,,40/4--300@10,INST D

SPL Blank QC Report

Matrix: Soil
Sample ID: 930610SNB1
Batch: EX930528000001

Reported on: 06/17/93 10:1
Analyzed on: 06/14/93 19:5
Analyst: GLT

Compound	Result	Detection Limit	Units
Pyridine	ND	330	µg/Kg
Phenol	ND	330	µg/Kg
Aniline	ND	330	µg/Kg
bis(2-Chloroethyl)Ether	ND	330	µg/Kg
2-Chlorophenol	ND	330	µg/Kg
1,3-Dichlorobenzene	ND	330	µg/Kg
1,4-Dichlorobenzene	ND	330	µg/Kg
Benzyl Alcohol	ND	330	µg/Kg
1,2-Dichlorobenzene	ND	330	µg/Kg
2-Methylphenol	ND	330	µg/Kg
bis(2-Chloroisopropyl)Ethe	ND	330	µg/Kg
4-Methylphenol	ND	330	µg/Kg
N-Nitroso-Di-n-Propylamine	ND	330	µg/Kg
Hexachloroethane	ND	330	µg/Kg
Nitrobenzene	ND	330	µg/Kg
Isophorone	ND	330	µg/Kg
2-Nitrophenol	ND	330	µg/Kg
2,4-Dimethylphenol	ND	330	µg/Kg
Benzoic Acid	ND	1600	µg/Kg
bis(2-Chloroethoxy)Methane	ND	330	µg/Kg
2,4-Dichlorophenol	ND	330	µg/Kg
1,2,4-Trichlorobenzene	ND	330	µg/Kg
Naphthalene	ND	330	µg/Kg
4-Chloroaniline	ND	330	µg/Kg
Hexachlorobutadiene	ND	330	µg/Kg
4-Chloro-3-Methylphenol	ND	330	µg/Kg
2-Methylnaphthalene	ND	330	µg/Kg
Hexachlorocyclopentadiene	ND	330	µg/Kg
2,4,6-Trichlorophenol	ND	330	µg/Kg
2,4,5-Trichlorophenol	ND	800	µg/Kg
2-Chloronaphthalene	ND	330	µg/Kg
2-Nitroaniline	ND	800	µg/Kg
Dimethyl Phthalate	ND	330	µg/Kg
Acenaphthylene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: 930610SNB1
Batch: EX930528000001

Reported on: 06/17/93 10:1
Analyzed on: 06/14/93 19:5
Analyst: GLT

Compound	Result	Detection Limit	Units
3-Nitroaniline	ND	800	µg/Kg
Acenaphthene	ND	330	µg/Kg
2,4-Dinitrophenol	ND	800	µg/Kg
4-Nitrophenol	ND	800	µg/Kg
Dibenzofuran	ND	330	µg/Kg
2,4-Dinitrotoluene	ND	330	µg/Kg
2,6-Dinitrotoluene	ND	330	µg/Kg
Diethylphthalate	ND	330	µg/Kg
4-Chlorophenylphenyl ether	ND	330	µg/Kg
Fluorene	ND	330	µg/Kg
4-Nitroaniline	ND	800	µg/Kg
4,6-Dinitro-2-Methylphenol	ND	800	µg/Kg
N-Nitrosodiphenylamine (1)	ND	330	µg/Kg
1,2-Diphenylhydrazine	ND	330	µg/Kg
4-Bromophenylphenyl ether	ND	330	µg/Kg
Hexachlorobenzene	ND	330	µg/Kg
Pentachlorophenol	ND	800	µg/Kg
Phenanthrene	ND	330	µg/Kg
Anthracene	ND	330	µg/Kg
Carbazole	ND	330	µg/Kg
Di-n-Butylphthalate	ND	330	µg/Kg
Fluoranthene	ND	330	µg/Kg
Pyrene	ND	330	µg/Kg
Butylbenzylphthalate	ND	330	µg/Kg
3,3'-Dichlorobenzidine	ND	330	µg/Kg
Benzo(a)anthracene	ND	330	µg/Kg
Chrysene	ND	330	µg/Kg
bis(2-Ethylhexyl)Phthalate	ND	330	µg/Kg
Di-n-Octyl Phthalate	ND	330	µg/Kg
Benzo(b)fluoranthene	ND	330	µg/Kg
Benzo(k)fluoranthene	ND	330	µg/Kg
Benzo(a)pyrene	ND	330	µg/Kg
Indeno(1,2,3-cd)pyrene	ND	330	µg/Kg
Dibenz(a,h)anthracene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

SPL

SPL Blank QC Report

Matrix: Soil
Sample ID: 930610SNB1
Batch: EX930528000001

Reported on: 06/17/93 10:1
Analyzed on: 06/14/93 19:3
Analyst: GLT

Compound	Result	Detection Limit	Units
Benzo(g,h,i)perylene	ND	330	µg/Kg

Surrogate	Result	QC Criteria	Units
Nitrobenzene-d5	84	23-120	% Recovery
2-Fluorobiphenyl	93	30-115	% Recovery
Terphenyl-d14	128	18-137	% Recovery
Phenol-d5	79	24-113	% Recovery
2-Fluorophenol	89	25-121	% Recovery
2,4,6-Tribromophenol	94	19-122	% Recovery

Samples in Batch 9306215-01 9306215-02

Notes

ND - Not detected.

Cynthia Schreiner, QC Officer

QUALITY CONTROL REPORT

SAMPLE ID: 9306215
DATE: 06/16/93
ANALYST: NDRC

METHOD

EPA 8330

COMPOUND	BLANK mg/Kg	SPIKE % RECOVERY	MS/MSD RPD	LCS RECOVERY	DUPLICATE RPD
RDX	< 1.0	98	0	102	---
TNT	< 0.25	97	0	96	---
2,4 DNT	< 0.25	93	0	96	---

ND = Parameter was analyzed for but not detected.

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 6/15/93 TIME: 10:20 AM. ANALYST: AP. MATRIX: Soil
INSTRUMENT: TJA 61E FILE #: A0615 METHOD: ICP UNITS: mg/L

SAMPLE ID NUMBERS: 6215 1A 2A 6217 1B - 3B 5B 6B 6110 1B - 5B 6C
6110 7B - 11B 12C

QC SAMPLE ID: 1). 6217 2B 2).

ELEMENT PB 6/9	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
AL	ND	75.9	11.41	16.97	39**	5.0	88.8	92.4	4
SB		103.1	ND	ND	N/A	1.0	95.9	101.7	6
BA		93.1	0.1531	0.1765	14	2.0	96.5	93.4	3
BE		92.7	ND	ND	N/A	0.05	104.0	103.2	1
CD		96.5	ND	ND		1.0	97.0	98.4	1
CR		75.0	~~0.0182~~ ND	0.0206		0.20	106.8	108.0	1
CO		93.0	ND	ND		0.50	92.9	92.8	0
CU		95.7	0.0133	0.0156		0.25	92.9	92.2	1
FE		68.5	6.403	10.66	50**	5.0	90.5	93.7	4
PB		91.9	ND	ND	N/A	0.50	92.0	88.0	4
MN		85.0	0.0810	0.0863	6	1.0	100.6	102.2	2
NI		87.3	ND	ND	N/A	0.50	91.1	92.2	1
AG		91.2	ND	ND		0.05	78.8	78.8	0
V		85.5	0.0188	0.0211		0.50	81.2	81.6	0
ZN		90.4	ND	0.0225		0.50	94.7	95.6	1
CA	***	88.3	9.809	8.717		10.0	92.9	95.5	3
MG		97.2	4.484	5.228	15		102.2	104.0	2
NA		92.5	0.5073	0.5225	N/A		101.3	102.0	1
K		91.5	1.332	1.924			92.6	90.8	2

FLAGS: **See case narrative. *Analytical Spike ***Samples at least 10 times blank read

SUPERVISOR APPROVAL: Meena Mariam
DATE: 6/16/93

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 6/15/93 INSTRUMENT: TJA 61E FILE #: A0615

PB 6/14

ELEMENT	METHOD BLANK	LCS %REC.
AG	ND	90.4
PB		92.1
BA		93.5
Cd		94.6
Cr	↓	84.3
AG	ND	91.4
PB		94.8
BA		95.8
Cd		96.9
Cr	↓	87.3

PB 6/11

PB 6/7

ELEMENT	METHOD BLANK	LCS %REC.
Al	ND	138.5
Sb		103.1
BA		96.1
Be		93.4
Cd		95.4
Cr		120.6
Co		98.6
Cu		95.1
Fe		125.5
PB		94.9
Mn		105.2
Ni		97.3
AG		86.9
V		94.6
ZN		93.4
CA	*	99.9
MG		112.9
NA		114.7
K	↓	102.7

FLAGS: *Samples at least 10 times prep blank reading

SUPERVISOR APPROVAL: Meaza Manian

DATE: 6/16/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/16/93 TIME: 07:55 ANALYST: WFC MATRIX: soil
INSTRUMENT: 30302 FILE #: 06(6A) METHOD: ~~GFAA~~ UNITS: mg/kg

ELEMENT: As

SAMPLE ID NUMBERS: 06110-1B-~~4B~~, 6C, ~~7B~~, 8B-11B, 12C.
06215-1A-2A; 06217-1B-3B, 5B, 8B;
06273-1B-6B.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
06110-8B	ND	96.9%	34.0	32.0	6	40.0	91.8%	91.8%	0
06215-1A	ND	84.3%	14.8	17.7	18	40.0	104.0%	100.0%	3.4
PD 6/10	ND	87.3%	—	—	—	40.0	—	—	—

FLAGS: _____

SUPERVISOR APPROVAL: Meaza Mariam
DATE: 6/16/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code CRHEX Date 6/17/93 Analyst KEW

Method HACH Time 1:00p Matrix SOIL

Of Samples in Set 3 Detection Limit 0.01

Sample #'s in Set					Units mg/Kg
		306445-1C			
		306215-1A, 2A			

Standards	EM, %T, (ABS)	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank	0.000	ND	ND	NA	NA	NA
#1 0.05 mg/L	STD 0.416	0.051	0.05	102.0	INSUFFICENT DATA	
#2						
#3						
#4						
Check Std. 0.10 mg/L		0.095	0.10	95.0	INSUFFICENT DATA	

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
306215-2A	ND	ND	0	INSUFFICENT DATA		

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
306445-1C	ND (24.5/25)	0.10	0.097	0.097	97.0	INSUFFICENT DATA	

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G Villarreal

Date 6/17/93

Approved By Reid Clark

Date 6/17/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/10/93 TIME: 8:26 ANALYST: [illegible] MATRIX: Soil
INSTRUMENT: B3030 FILE #: 0610A METHOD: CVAA UNITS: ug/L

ELEMENT: Hg

SAMPLE ID NUMBERS: 6215-1A, 2A ; 6217-1B - 3B, 5A, 6B

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
6215-1A	ND	88.0	ND	ND	N/A	2.00	107.0	106.5	0

FLAGS:

SUPERVISOR APPROVAL: Meagan Marion
DATE: 6/10/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code MOISEP Date 6-9-93 Analyst Y.N

Method Gravimetric Time 8:30 a.m Matrix Soil

Of Samples in Set 16 Detection Limit 1

Sample #'s in Set				Units % wt
306215-1A → 2A	306217-1B → 3B			
306217-5B → 6B	306219-1B → 8B	306225-1D		

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank	N/A					
#1						
#2						
#3						
#4						
Check Std.						

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
306217-6B	14	14	0-0	30.4	22.4	1
306219-8B	14	13	7-4	↓	↓	↓

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
N/A							

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G Villarreal

Date 6/9/93

Approved By [signature]

Date 6/9/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/16/93 TIME: 13:22 ANALYST: WFK MATRIX: Soil
INSTRUMENT: 2030Z FILE #: 0616B METHOD: ~~GFAA~~ UNITS: mg/kg

ELEMENT: SE

SAMPLE ID NUMBERS: 06110-1B-5B, 6, 7B-1B, 12, 6126-04B, 06215-1A-2A, 06217-1B-3B, 5B, 6B, 06273-1B-6B.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
06110-8B	ND	97.1%	ND	ND	NA	30.0	99.3%	84.3%	16
06215-1A	ND	98.0%	11.0	10.8	2	30.0	*91.7%	*87.0%	4
PB 6/10	ND	97.1%	—	—	—	30.0	—	—	—
PB 6/15	ND	102.3%	—	—	—	30.0	—	—	—

FLAGS: * QC samples were analytically spiked.

SUPERVISOR APPROVAL: Meaza Marian
DATE: 6/17/93

SPL
8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code TOCS
Method 415.1
Of Samples in Set 7

Date 6.21.93
Time 8:00am

Analyst DAM
Matrix PRPTOC
Detection Limit 1

Sample #'s in Set	9306215-1E&2E	9306445-1E	9306491-1C→4C	

Units Mg/Kg

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank		ND	ND	NA		
#1		10.21	10.0	102.1	108.94	92.42
#2		50.25	50.0	100.5	↓	↓
#3		100.0	100.0	100		
#4		200.1	200.0	100		
Check Std.		41.08	41.0	100.2	45.1	39.6

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
6215-2E	207	207	0	11.0	8.1	1
6491-2C	758	761	0.4	↓	↓	1

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
6445-1E	15.94	40.0	55.54	39.6	99	120.1	70.8
6441-4C	25.81	40.0	66.08	40.27	100.7	↓	↓

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G. Villarreal

Date 6/22/93

Approved By [signature]

Date 6/22/93

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

SPL ENVIRONMENTAL LABORATORIES, INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02011.01	Viro Group Inc / Colfax R&D	Colfax LA

Field Sample No / Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	METHOD	LABORATORY REMARKS
S-1@6'	6.2.93 1400	X			Soil	ICE	Metals		
S-1@6'	" "	X			Soil	"	Volatile		
S-1@6'	"	X			Soil	"	Semi Volatile		
S-1@6'	"	X			Soil	"	TCLP		
SP-1@6'	"	X			Soil	"	Metals	6/17/93	Per Annette @ SPL
SP-1@6'	"	X			Soil		Volatiles	New Orleans add TOC to	
SP-1@6'	"	X		"	Soil		Semi Volatiles	both samples.	
SP-1@6'	"	X			Soil		HPLC		

Samplers (Signature)	Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Intact
Alan Piechocki	Alan Piechocki	Date: 6/6/93 Time: 7:30 PM	Mary Jo Rochocki	Date: 6/7/93 Time:	
Affiliation	Relinquished by: (Signature) Mary Jo Rochocki	Date 6/7/93 Time: 11:00 AM	Received by: (Signature) Rhona Hendra	Date: 6/07/93 Time: 11:00 AM	Intact
Viro Group	Relinquished by: (Signature) Rhona Hendra	Date: 6/07/93 Time: 4:00pm	Received by: (Signature)	Date: 6/8/93 Time: 11:16	Intact 4°C

REPORT TO:

6/14 Al Piechocki called with new list of metals
Al, As, Ba, Be, Cd, Crhex, Cu, Hg (already analyzed for before list was changed) will add to list
Ni, Pb, Sb, Se, Zn

SPL HOUSTON ENVIRONMENTAL LABORATORY

SAMPLE LOGIN CHECKLIST

DATE: 6/8/93 TIME: 11:15 CLIENT NO. _____
LOT NO. _____ CONTRACT NO. _____

CLIENT SAMPLE NOS. _____

SPL SAMPLE NOS.: _____

		YES	NO
1.	Is a Chain-of-Custody form present?	✓	
2.	Is the COC properly completed?	✓	
	If no, describe what is incomplete:		
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
3.	Is airbill/packing list/bill of lading with shipment? If yes, ID#: John T.		✓
4.	Is a USEPA Traffic Report present?		✓
5.	Is a USEPA SAS Packing List present?		✓
6.	Are custody seals present on the package?		
	If yes, were they intact upon receipt?		
7.	Are all samples tagged or labeled?	✓	
	Do the sample tags/labels match the COC?		
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
8.	Do all shipping documents agree? If no, describe what is in nonconformity:		

9. Condition/temperature of shipping container: intact-4°C
10. Condition/temperature of sample bottles: Good-4°C
11. Sample Disposal?: SPL disposal ✓ Return to client ____

NOTES (reference item number if applicable): _____

ATTEST: _____ DATE: 6/6/93
DELIVERED FOR RESOLUTION: REC'D _____ DATE: _____
RESOLVED: _____ DATE: _____

QUALITY CONTROL DOCUMENTATION

" 2D '

SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306445 SAS No.: _____ SDG No.: 306445

Level: (low/med) LOW

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (TPH) #	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	S7 (2CP) #	S8 (DCB) #	TOT OUT
01	SMW1_5_6_	99	94	113	69	95	93	79	80	0
02	SBLK01	86	67	70	75	79	86	76	70	0

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(23-120)	
S2 (FBP)	= 2-Fluorobiphenyl	(30-115)	
S3 (TPH)	= Terphenyl-d14	(18-137)	
S4 (PHL)	= Phenol-d5	(24-113)	
S5 (2FP)	= 2-Fluorophenol	(25-121)	
S6 (TBP)	= 2,4,6-Tribromophenol	(19-122)	
S7 (2CP)	= 2-Chlorophenol-d4	(20-130)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(20-130)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

" 3D'

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306408 SAS No.: _____ SDG No.: 306445

Matrix Spike - EPA Sample No.: SB-1D Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Phenol	3010	0	2202	73	26- 90
2-Chlorophenol	3010	0	2154	72	25-102
1,4-Dichlorobenzene	2010	0	1286	64	28-104
N-Nitroso-di-n-prop.(1)	2010	0	1607	80	41-126
1,2,4-Trichlorobenzene	2010	0	1342	67	38-107
4-Chloro-3-methylphenol	3010	0	2065	69	26-103
Acenaphthene	2010	0	1503	75	31-137
4-Nitrophenol	3010	0	2041	68	11-114
2,4-Dinitrotoluene	2010	0	1471	73	28- 89
Pentachlorophenol	3010	0	1921	64	17-109
Pyrene	2010	0	1197	60	35-142

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	3010	2363	78	7	35	26- 90
2-Chlorophenol	3010	2282	76	5	50	25-102
1,4-Dichlorobenzene	2010	1318	66	3	27	28-104
N-Nitroso-di-n-prop.(1)	2010	1680	84	5	38	41-126
1,2,4-Trichlorobenzene	2010	1446	72	7	23	38-107
4-Chloro-3-methylphenol	3010	2242	74	7	33	26-103
Acenaphthene	2010	1567	78	4	19	31-137
4-Nitrophenol	3010	1872	62	9	50	11-114
2,4-Dinitrotoluene	2010	1567	78	7	47	28- 89
Pentachlorophenol	3010	1535	51	23	47	17-109
Pyrene	2010	1262	63	5	36	35-142

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: 8270,306408,,SB-1D,L,S,9306408-02C,B,E,30-1,6/16 DE-2UL
CAP,0617S2F1,0617DFF1,,,,,40/4--300@10,INST F

" 4B "

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

SBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306445 SAS No.: _____ SDG No.: 306445

Lab File ID: 0616SSBKF1 Lab Sample ID: 930616SNB1

Instrument ID: F Date Extracted: 06/16/93

Matrix: (soil/water) SOIL Date Analyzed: 06/17/93

Level: (low/med) LOW Time Analyzed: 1536

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	SMW1_5_6_	9306445-01B	B644501	06/17/93

COMMENTS: SPL,BLANK,,SBLK01,L,S,930616SNB1,B,B,0-1,6/16 DE-2UL CAP,0617S2F1,0617DFF1,,,,,40/4--300@10,INST F

SPL Blank QC Report

Matrix: Soil
Sample ID: 930616SNB1
Batch: EX930616000001

Reported on: 06/21/93 15:4
Analyzed on: 06/17/93 15:3
Analyst: ADK

Compound	Result	Detection Limit	Units
Pyridine	ND	330	µg/Kg
Phenol	ND	330	µg/Kg
Aniline	ND	330	µg/Kg
bis(2-Chloroethyl)Ether	ND	330	µg/Kg
2-Chlorophenol	ND	330	µg/Kg
1,3-Dichlorobenzene	ND	330	µg/Kg
1,4-Dichlorobenzene	ND	330	µg/Kg
Benzyl Alcohol	ND	330	µg/Kg
1,2-Dichlorobenzene	ND	330	µg/Kg
2-Methylphenol	ND	330	µg/Kg
bis(2-Chloroisopropyl)Ethe	ND	330	µg/Kg
4-Methylphenol	ND	330	µg/Kg
N-Nitroso-Di-n-Propylamine	ND	330	µg/Kg
Hexachloroethane	ND	330	µg/Kg
Nitrobenzene	ND	330	µg/Kg
Isophorone	ND	330	µg/Kg
2-Nitrophenol	ND	330	µg/Kg
2,4-Dimethylphenol	ND	330	µg/Kg
Benzoic Acid	ND	1600	µg/Kg
bis(2-Chloroethoxy)Methane	ND	330	µg/Kg
2,4-Dichlorophenol	ND	330	µg/Kg
1,2,4-Trichlorobenzene	ND	330	µg/Kg
Naphthalene	ND	330	µg/Kg
4-Chloroaniline	ND	330	µg/Kg
Hexachlorobutadiene	ND	330	µg/Kg
4-Chloro-3-Methylphenol	ND	330	µg/Kg
2-Methylnaphthalene	ND	330	µg/Kg
Hexachlorocyclopentadiene	ND	330	µg/Kg
2,4,6-Trichlorophenol	ND	330	µg/Kg
2,4,5-Trichlorophenol	ND	800	µg/Kg
2-Chloronaphthalene	ND	330	µg/Kg
2-Nitroaniline	ND	800	µg/Kg
Dimethyl Phthalate	ND	330	µg/Kg
Acenaphthylene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: 930616SNB1
Batch: EX930616000001

Reported on: 06/21/93 15:4
Analyzed on: 06/17/93 15:3
Analyst: ADK

Compound	Result	Detection Limit	Units
3-Nitroaniline	ND	800	µg/Kg
Acenaphthene	ND	330	µg/Kg
2,4-Dinitrophenol	ND	800	µg/Kg
4-Nitrophenol	ND	800	µg/Kg
Dibenzofuran	ND	330	µg/Kg
2,4-Dinitrotoluene	ND	330	µg/Kg
2,6-Dinitrotoluene	ND	330	µg/Kg
Diethylphthalate	ND	330	µg/Kg
4-Chlorophenylphenyl ether	ND	330	µg/Kg
Fluorene	ND	330	µg/Kg
4-Nitroaniline	ND	800	µg/Kg
4,6-Dinitro-2-Methylphenol	ND	800	µg/Kg
N-Nitrosodiphenylamine (1)	ND	330	µg/Kg
1,2-Diphenylhydrazine	ND	330	µg/Kg
4-Bromophenylphenyl ether	ND	330	µg/Kg
Hexachlorobenzene	ND	330	µg/Kg
Pentachlorophenol	ND	800	µg/Kg
Phenanthrene	ND	330	µg/Kg
Anthracene	ND	330	µg/Kg
Carbazole	ND	330	µg/Kg
Di-n-Butylphthalate	ND	330	µg/Kg
Fluoranthene	ND	330	µg/Kg
Pyrene	ND	330	µg/Kg
Butylbenzylphthalate	ND	330	µg/Kg
3,3'-Dichlorobenzidine	ND	330	µg/Kg
Benzo(a)anthracene	ND	330	µg/Kg
Chrysene	ND	330	µg/Kg
bis(2-Ethylhexyl)Phthalate	ND	330	µg/Kg
Di-n-Octyl Phthalate	ND	330	µg/Kg
Benzo(b)fluoranthene	ND	330	µg/Kg
Benzo(k)fluoranthene	ND	330	µg/Kg
Benzo(a)pyrene	ND	330	µg/Kg
Indeno(1,2,3-cd)pyrene	ND	330	µg/Kg
Dibenz(a,h)anthracene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL

SPL Blank QC Report page

Matrix: Soil
Sample ID: 930616SNB1
Batch: EX930616000001

Reported on: 06/21/93 15:4
Analyzed on: 06/17/93 15:3
Analyst: ADK

Compound	Result	Detection Limit	Units
Benzo(g,h,i)perylene	ND	330	µg/Kg

Surrogate	Result	QC Criteria	Units
Nitrobenzene-d5	86	23-120	% Recovery
2-Fluorobiphenyl	67	30-115	% Recovery
Terphenyl-d14	70	18-137	% Recovery
Phenol-d5	75	24-113	% Recovery
2-Fluorophenol	79	25-121	% Recovery
2,4,6-Tribromophenol	86	19-122	% Recovery

Samples in Batch 9306445-01

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SOIL VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306445 SAS No.: _____ SDG No.: 306445

Level: (low/med) LOW

	EPA SAMPLE NO.	SMC1 (TOL)#	SMC2 (BFB)#	SMC3 (DCE)#	OTHER	TOT OUT
01	SMW1_5_6_	102	87	92	0	0
02	VSBLK01	105	95	90	0	0

		QC LIMITS
SMC1 (TOL)	= Toluene-d8	(84-138)
SMC2 (BFB)	= Bromofluorobenzene	(59-113)
SMC3 (DCE)	= 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306445 SAS No.: _____ SDG No.: 306445

Matrix Spike - EPA Sample No.: SMW1_5_6 Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	60.20	0	60.60	101	59-172
Trichloroethene	60.20	0	60.72	101	62-137
Benzene	60.20	0	59.16	98	66-142
Toluene	60.20	0	58.19	97	59-139
Chlorobenzene	60.20	0	59.88	99	60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	60.20	73.13	122	19	22	59-172
Trichloroethene	60.20	61.32	102	1	24	62-137
Benzene	60.20	61.57	102	4	21	66-142
Toluene	60.20	62.89	104	7	21	59-139
Chlorobenzene	60.20	62.05	103	4	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: 8240S/TICS,306445,,SMW1'@5.6',L,S,9306445-01A,V,E,X1,
PACK,0623VS2A1,0623BFA1,0623VSBA1,,,,45/3-220@8,INST A,

"4A "

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VSBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306445 SAS No.: _____ SDG No.: 306445

Lab File ID: 0623VSBA1 Lab Sample ID: VSBLK010623A

Date Analyzed: 06/23/93 Time Analyzed: 1441

GC Column: PACK ID: 2.00(mm) Heated Purge: (Y/N) Y

Instrument ID: A

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	SMW1_5_6_	9306445-01A	V644501A	1752

COMMENTS: SPL,BLANK,,VSBLK01,L,S,VSBLK010623A,V,B,5MLS,
PACK,0623VS2A1,0623BFA1,,,,,45/3-220@8,INST A,

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010623
Batch: VOA930623075300

Reported on: 06/25/93 09:
Analyzed on: 06/23/93 14:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Chloromethane	ND	10	µg/Kg
Bromomethane	ND	10	µg/Kg
Vinyl Chloride	ND	10	µg/Kg
Chloroethane	ND	10	µg/Kg
Methylene Chloride	ND	5	µg/Kg
Acetone	ND	10	µg/Kg
Carbon Disulfide	ND	5	µg/Kg
Trichlorofluoromethane	ND	5	µg/Kg
1,1-Dichloroethene	ND	5	µg/Kg
1,1-Dichloroethane	ND	5	µg/Kg
total-1,2-Dichloroethene	ND	5	µg/Kg
Chloroform	ND	5	µg/Kg
1,2-Dichloroethane	ND	5	µg/Kg
2-Butanone	ND	20	µg/Kg
1,1,1-Trichloroethane	ND	5	µg/Kg
Carbon Tetrachloride	ND	5	µg/Kg
Vinyl Acetate	ND	10	µg/Kg
Bromodichloromethane	ND	5	µg/Kg
1,2-Dichloropropane	ND	5	µg/Kg
Trichloroethene	ND	5	µg/Kg
Dibromochloromethane	ND	5	µg/Kg
1,1,2-Trichloroethane	ND	5	µg/Kg
Benzene	ND	5	µg/Kg
cis-1,3-Dichloropropene	ND	5	µg/Kg
trans-1,3-Dichloropropene	ND	5	µg/Kg
2-Chloroethylvinylether	ND	10	µg/Kg
Bromoform	ND	5	µg/Kg
4-Methyl-2-Pentanone	ND	10	µg/Kg
2-Hexanone	ND	10	µg/Kg
Tetrachloroethene	ND	5	µg/Kg
1,1,2,2-Tetrachloroethane	ND	5	µg/Kg
Toluene	ND	5	µg/Kg
Chlorobenzene	ND	5	µg/Kg
Ethylbenzene	ND	5	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

page

Matrix: Soil
Sample ID: VSBLK010623
Batch: VOA930623075300

Reported on: 06/25/93 09
Analyzed on: 06/23/93 14
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Styrene	ND	5	µg/Kg
Xylene (total)	ND	5	µg/Kg

Surrogate	Result	QC Criteria	Units
Toluene-d8	105	84-138	% Recovery
4-Bromofluorobenzene	95	59-113	% Recovery
1,2-Dichloroethane-d4	90	70-121	% Recovery

Samples in Batch 9306445-01

Notes

ND - Not detected.

Cynthia Schreiner, QC Officer

QUALITY CONTROL REPORT

SAMPLE ID: 9306445
DATE: 06/25/93
ANALYST: NDRC

METHOD

EPA 8330

COMPOUND	BLANK mg/Kg	SPIKE % RECOVERY	MS/MSD RPD	LCS RECOVERY	DUPLICATE RPD
RDX	< 1.0	85.0	0	103	---
TNT	< 0.25	88	0	104	---
2,4 DNT	< 0.25	86.0	0	103	---
2,6 DNT	< 0.26	101	1.0	102	---

ND = Parameter was analyzed for but not detected.

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 6/21/93 TIME: 11:32 AM. ANALYST: AB. MATRIX: Soil
INSTRUMENT: TJA 61E FILE #: A0621 METHOD: ICP UNITS: mg/L.

SAMPLE ID NUMBERS: 6434 1A - 4A, 6445 1C, 6519 1B, 6491 1A - 4A

QC SAMPLE ID: 1). 6445 1C 2).

ELEMENT	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
As	ND	118.7	0.4563	0.3647	N/A	2.0	106.1	111.2	5
Cu		93.0	0.0228	0.0244	N/A	0.25	108.4	110.3	2
Fe		86.8	54.90	54.20	1	10.0	75.5	87.9	15
Pb		98.9	0.1183	0.1232	N/A	0.50	106.6	105.6	1
Zn		92.8	0.0521	0.0503	N/A	0.50	104.2	107.1	3
Al		89.6	67.97	67.12	1	10.0	80.1	94.2	16
Ba		91.3	0.3826	0.3792	1	2.0	102.1	104.4	2
Ni		88.8	ND	ND	N/A	0.50	112.9	110.4	2
Be		92.5	ND	ND		0.05	110.8	110.8	0
Cd		98.3	ND	ND		1.0	103.8	105.5	2
Sb		78.8	ND	ND		0.50	102.8	99.2	4
Ag		95.2	ND	ND		1.0	104.3	104.8	0
Cr		89.2	0.0585	0.0544	N/A	0.2	111.4	112.4	1

FLAGS: *Analytical Spike

SUPERVISOR APPROVAL: Meena Mariam
DATE: 6/22/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/18/93 TIME: 06:59 ANALYST: WFC MATRIX: Soil
INSTRUMENT: 30302 FILE #: 0618A METHOD: GFAA UNITS: mg/kg

ELEMENT: AS

SAMPLE ID NUMBERS: 06126-4B; 06110-5B; 06405-1C; 06429-1E; 06307-3B-6B; 06407-1B-3B, 5B, 7B-9B; 06363-4B-5B; 06387-1B-3B.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
06429-1E	ND	81.9%	ND	ND	NA	40.0	84.8%	85.2%	0
06307-6B	ND	78.4%	21.0	22.2	6	40.0	100.0%	97.8%	2
PB 6/11	ND	83.1%	—	—	—	40.0	—	—	—

FLAGS: _____

SUPERVISOR APPROVAL: Marga Marion
DATE: 6/18/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code CRHEX
Method HACH
Of Samples in Set 3

Date 6/17/93
Time 1:00P

Analyst KEW
Matrix SOIL
Detection Limit 0.01

Sample #'s in Set: 306445-1C; 306215-1A, 2A

Units mg/Kg

Standards	EM, %T, (ABS)	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank	0.000	ND	ND	NA	NA	NA
#1 0.05 mg/L	STD 0.416	0.051	0.05	102.0	INSUFFICENT DATA	
#2						
#3						
#4						
Check Std. 0.10 mg/L		0.095	0.10	95.0	INSUFFICENT DATA	

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
306215-2A	ND	ND	0	INSUFFICENT DATA		

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
306445-1C	ND (24.5/25)	0.10	0.097	0.097	97.0	INSUFFICENT DATA	

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G Villarreal

Date 6/17/93

Approved By Paul Clark

Date 6/17/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/17/93 TIME: 8:54 ANALYST: JM MATRIX: Soil
INSTRUMENT: B3030 FILE #: 0617A METHOD: CVAA UNITS: ug/L

ELEMENT: Hg

SAMPLE ID NUMBERS: 6126-4B ; ~~6408-2E~~ ; 6407-1B, 3B, 5B, 7B, 8B, 9B
6387-1B-3B ; 6429-1E ; 6445-1C

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
6408-2E	ND	108.3	ND	ND	N/A	2.00	107.5	115.5	7

FLAGS:

SUPERVISOR APPROVAL: Meena Narian
DATE: 6/17/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code MOISEP Date 6-16-93 Analyst DSE

Method GRAVIMETRIC Time 7:20AM Matrix SOIL

Of Samples in Set 14 Detection Limit 1

Sample #'s in Set					Units % WEIGHT.
306442-3C	306431-1E	306429-1E			
306126-4B	306443-4C	306445-1C			
306441-3C	306433-4C-76C	306434-1A->4A			

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank						
#1						
#2						
#3						
#4						
Check Std.						

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
306434-3A	3	3	0	30.4	22.4	
-4A	3	3	0	↓	↓	

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By _____

Date 6/16/93

Approved By _____

Date 6/16/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 6/18/93 TIME: 13:08 ANALYST: WFL MATRIX: Soil
INSTRUMENT: 30302 FILE #: 0618B METHOD: GFAA UNITS: mg/kg

ELEMENT: SE

SAMPLE ID NUMBERS: 06445-1c; 06429-1E

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
06429-1E	ND	73.2%	ND	ND	NA	30.0	80.3%*	83.0%*	3

FLAGS: Analytical spike

SUPERVISOR APPROVAL: Neeza Narain
DATE: 6/18/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code N03N02 Date 6-25-93 Analyst Y.N
Method 353.3 Time 8:00 a.m Matrix LIQUID
Of Samples in Set 4 Detection Limit 0.1

Sample #'s in Set	306445-1B	306499-1F	306450-2C	306708-1F	Units mg/L

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank		ND	ND			
#1	Column 'A'	0.55	0.50	110.0	125.3	75.0
#2	'B'	0.50	0.50	100.0		
#3	'C'	0.52	0.50	104.0		
#4	'D'	0.50	0.50	100.0		
Check Std.		2.16	2.00	108.0	2.27	1.71

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
306445-1B	ND	ND	N/C	15.38	11.45	1

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
306499-1F	ND	0.25	0.23	0.23	92.0	insufficent	
						data.	

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G. Villarreal

Date 6/25/93

Approved By [signature]

Date 6/25/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code TOCS
Method 415.1
Of Samples in Set 7

Date 6.21.93
Time 8:00am

Analyst DAM
Matrix PRPTOC
Detection Limit 1

Sample #'s in Set	9306215-1E&2E	9306445-1E	9306491-1C→4C	

Units mg/kg

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank		ND	ND	NA		
#1		10.21	10.0	102.1	108.94	92.42
#2		50.25	50.0	100.5	↓	↓
#3		100.0	100.0	100	↓	↓
#4		200.1	200.0	100	↓	↓
Check Std.		41.08	41.0	100.2	45.1	39.6

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
6215-2E	207	207	0	11.0	8.1	1
6491-2C	758	761	0.4	↓	↓	1

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
6445-1E	15.94	40.0	55.54	39.6	99	120.1	70.8
6491-4C	25.81	40.0	66.68	40.27	100.7	↓	↓

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G. Villarreal

Date 6/22/93

Approved By [signature]

Date 6/22/93

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

SPL ENVIRONMENTAL LABORA[illegible], INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02011.01	ViroGroup / Colfax R&D	Colfax, LA

Field Sample No / Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	ANALYSIS REQUESTED METHOD	LABORATORY REMARKS
SMW1@56'	6-9-93 1245	X		50ml	Soil	Ice	Semi Vol		
SMW1-056'	"	X		250ml	Soil	Ice	Metals		
SMW1-056'	"	X		250ml	Soil	Ice	HPLC		
SMW1-056'	"	X		250ml	Soil	Ice	Volatiles		

Sampler: (Signature)	Relinquished by: (Signature)	Date: 6/14/93 Time: 1135	Received by: (Signature)	Date: 6/14/93 Time: 1135	Intact
Affiliation	Relinquished by: (Signature)	Date: 6-14-93 Time: 3:00pm	Received by: (Signature)	Date: Time:	Intact
	Relinquished by: (Signature)	Date: Time:	Received by: (Signature)	Date: 6/15/93 Time: 12:00	Intact 4° C

REPORT TO:

P.O. # 07068 please put on invoice

SPL HOUSTON ENVIRONMENTAL LABORATORY

SAMPLE LOGIN CHECKLIST

DATE: 6/15/93 TIME: 12:00 CLIENT NO. _____
LOT NO. _____ CONTRACT NO. _____

CLIENT SAMPLE NOS. _____

SPL SAMPLE NOS.: _____

		YES	NO
1.	Is a Chain-of-Custody form present?	✓	
2.	Is the COC properly completed?	✓	
	If no, describe what is incomplete:		
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
3.	Is airbill/packing list/bill of lading with shipment?		✓
	If yes, ID#: By Hand		
4.	Is a USEPA Traffic Report present?		✓
5.	Is a USEPA SAS Packing List present?		✓
6.	Are custody seals present on the package?		
	If yes, were they intact upon receipt?		
7.	Are all samples tagged or labeled?	✓	
	Do the sample tags/labels match the COC?		
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
8.	Do all shipping documents agree?		
	If no, describe what is in nonconformity:		

9. Condition/temperature of shipping container: Intact 4°C
10. Condition/temperature of sample bottles: Good 4°C
11. Sample Disposal?: SPL disposal ✓ Return to client _____

NOTES (reference item number if applicable): _____

ATTEST: _____ DATE: 6/15/93
DELIVERED FOR RESOLUTION: REC'D _____ DATE: _____
RESOLVED: _____ DATE: _____

QUALITY CONTROL DOCUMENTATION

2B

SOIL VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307161 SAS No.: _____ SDG No.: 307161

Level: (low/med) LOW

	EPA SAMPLE NO.	SMC1 (TOL) #	SMC2 (BFB) #	SMC3 (DCE) #	OTHER	TOT OUT
01	P-25_4FT_	113	104	77	0	0
02	VSBLK01	101	104	76	0	0

		QC LIMITS
SMC1 (TOL)	= Toluene-d8	(84-138)
SMC2 (BFB)	= Bromofluorobenzene	(59-113)
SMC3 (DCE)	= 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307137 SAS No.: _____ SDG No.: 307161

Matrix Spike - EPA Sample No.: WS-063093-3 Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50.00	0	47.70	95	59-172
Trichloroethene	50.00	0	47.20	94	62-137
Benzene	50.00	0	49.40	99	66-142
Toluene	50.00	0	53.50	107	59-139
Chlorobenzene	50.00	0	51.10	102	60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50.00	45.50	91	4	22	59-172
Trichloroethene	50.00	47.70	95	1	24	62-137
Benzene	50.00	47.00	94	5	21	66-142
Toluene	50.00	53.10	106	1	21	59-139
Chlorobenzene	50.00	52.40	105	3	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: 8240S,307137,,WS-063093-3,L,S,9307137-03C,V,E,X1,
PACK,0709VS2A1,0709BFA1,0709VSBA1,,,,45/3-220@8,INST A,

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VSBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307161 SAS No.: _____ SDG No.: 307161

Lab File ID: 0709VSBA1 Lab Sample ID: VSBLK010709A

Date Analyzed: 07/09/93 Time Analyzed: 0848

GC Column: PACK ID: 2.00(mm) Heated Purge: (Y/N) Y

Instrument ID: A

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	P-25_4FT_	9307161-01A	V716101	1127

COMMENTS: SPL,BLANK,,VSBLK01,L,S,VSBLK010709A,V,B,5MLS,
PACK,0709VS2A1,0709BFA1,,,,,45/3-220@8,INST A,

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010709
Batch: VOA930709072300

Reported on: 07/13/93 17:
Analyzed on: 07/09/93 08:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Chloromethane	ND	10	µg/Kg
Bromomethane	ND	10	µg/Kg
Vinyl Chloride	ND	10	µg/Kg
Chloroethane	ND	10	µg/Kg
Methylene Chloride	ND	5	µg/Kg
Acetone	ND	10	µg/Kg
Carbon Disulfide	ND	5	µg/Kg
Trichlorofluoromethane	ND	5	µg/Kg
1,1-Dichloroethene	ND	5	µg/Kg
1,1-Dichloroethane	ND	5	µg/Kg
total-1,2-Dichloroethene	ND	5	µg/Kg
Chloroform	ND	5	µg/Kg
1,2-Dichloroethane	ND	5	µg/Kg
2-Butanone	ND	20	µg/Kg
1,1,1-Trichloroethane	ND	5	µg/Kg
Carbon Tetrachloride	ND	5	µg/Kg
Vinyl Acetate	ND	10	µg/Kg
Bromodichloromethane	ND	5	µg/Kg
1,2-Dichloropropane	ND	5	µg/Kg
Trichloroethene	ND	5	µg/Kg
Dibromochloromethane	ND	5	µg/Kg
1,1,2-Trichloroethane	ND	5	µg/Kg
Benzene	ND	5	µg/Kg
cis-1,3-Dichloropropene	ND	5	µg/Kg
trans-1,3-Dichloropropene	ND	5	µg/Kg
2-Chloroethylvinylether	ND	10	µg/Kg
Bromoform	ND	5	µg/Kg
4-Methyl-2-Pentanone	ND	10	µg/Kg
2-Hexanone	ND	10	µg/Kg
Tetrachloroethene	ND	5	µg/Kg
1,1,2,2-Tetrachloroethane	ND	5	µg/Kg
Toluene	ND	5	µg/Kg
Chlorobenzene	ND	5	µg/Kg
Ethylbenzene	ND	5	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010709
Batch: VOA930709072300

Reported on: 07/13/93 17:
Analyzed on: 07/09/93 08:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Styrene	ND	5	µg/Kg
Xylene (total)	ND	5	µg/Kg

Surrogate	Result	QC Criteria	Units
Toluene-d8	101	84-138	% Recovery
4-Bromofluorobenzene	104	59-113	% Recovery
1,2-Dichloroethane-d4	76	70-121	% Recovery

Samples in Batch 9307161-01

Notes

ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

2D

SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307161 SAS No.: _____ SDG No.: 307161

Level: (low/med) LOW

	EPA SAMPLE NO.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#	S7 (2CP)#	S8 (DCB)#	TOT OUT
01	P-25	91	79	83	84	87	99	84	77	0
02	SBLK01	89	84	98	87	93	92	98	81	0

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(23-120)	
S2 (FBP)	= 2-Fluorobiphenyl	(30-115)	
S3 (TPH)	= Terphenyl-d14	(18-137)	
S4 (PHL)	= Phenol-d5	(24-113)	
S5 (2FP)	= 2-Fluorophenol	(25-121)	
S6 (TBP)	= 2,4,6-Tribromophenol	(19-122)	
S7 (2CP)	= 2-Chlorophenol-d4	(20-130)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(20-130)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 306408 SAS No.: _____ SDG No.: 307161

Matrix Spike - EPA Sample No.: SB-1D Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Phenol	3010	0	2202	73	26- 90
2-Chlorophenol	3010	0	2154	72	25-102
1,4-Dichlorobenzene	2010	0	1286	64	28-104
N-Nitroso-di-n-prop.(1)	2010	0	1607	80	41-126
1,2,4-Trichlorobenzene	2010	0	1342	67	38-107
4-Chloro-3-methylphenol	3010	0	2065	69	26-103
Acenaphthene	2010	0	1503	75	31-137
4-Nitrophenol	3010	0	2041	68	11-114
2,4-Dinitrotoluene	2010	0	1471	73	28- 89
Pentachlorophenol	3010	0	1921	64	17-109
Pyrene	2010	0	1197	60	35-142

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	3010	2363	78	7	35	26- 90
2-Chlorophenol	3010	2282	76	5	50	25-102
1,4-Dichlorobenzene	2010	1318	66	3	27	28-104
N-Nitroso-di-n-prop.(1)	2010	1680	84	5	38	41-126
1,2,4-Trichlorobenzene	2010	1446	72	7	23	38-107
4-Chloro-3-methylphenol	3010	2242	74	7	33	26-103
Acenaphthene	2010	1567	78	4	19	31-137
4-Nitrophenol	3010	1872	62	9	50	11-114
2,4-Dinitrotoluene	2010	1567	78	7	47	28- 89
Pentachlorophenol	3010	1535	51	23	47	17-109
Pyrene	2010	1262	63	5	36	35-142

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: 8270,306408,,SB-1D,L,S,9306408-02C,B,E,30-1,6/16 DE-2UL
CAP,0617S2F1,0617DFF1,,,,,40/4--300@10,INST F

4B

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

SBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307161 SAS No.: _____ SDG No.: 307161

Lab File ID: E4263 Lab Sample ID: 930709SNB1

Instrument ID: E Date Extracted: 07/09/93

Matrix: (soil/water) SOIL Date Analyzed: 07/12/93

Level: (low/med) LOW Time Analyzed: 1244

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	P-25	9307161-01B	E4283	07/13/93

COMMENTS: ,BLANK,,SBLK01,L,W,930709SNB1,B,B,C,E,
C,E4261,E4260,,,,,E

SPL Blank QC Report

Matrix: Soil
Sample ID: 930709SNB1
Batch: EX930709000001

Reported on: 07/15/93 11:
Analyzed on: 07/12/93 12:
Analyst: LH

Compound	Result	Detection Limit	Units
Pyridine	ND	330	µg/Kg
Phenol	ND	330	µg/Kg
Aniline	ND	330	µg/Kg
bis(2-Chloroethyl)Ether	ND	330	µg/Kg
2-Chlorophenol	ND	330	µg/Kg
1,3-Dichlorobenzene	ND	330	µg/Kg
1,4-Dichlorobenzene	ND	330	µg/Kg
Benzyl Alcohol	ND	330	µg/Kg
1,2-Dichlorobenzene	ND	330	µg/Kg
2-Methylphenol	ND	330	µg/Kg
bis(2-Chloroisopropyl)Ethe	ND	330	µg/Kg
4-Methylphenol	ND	330	µg/Kg
N-Nitroso-Di-n-Propylamine	ND	330	µg/Kg
Hexachloroethane	ND	330	µg/Kg
Nitrobenzene	ND	330	µg/Kg
Isophorone	ND	330	µg/Kg
2-Nitrophenol	ND	330	µg/Kg
2,4-Dimethylphenol	ND	330	µg/Kg
Benzoic Acid	ND	1600	µg/Kg
bis(2-Chloroethoxy)Methane	ND	330	µg/Kg
2,4-Dichlorophenol	ND	330	µg/Kg
1,2,4-Trichlorobenzene	ND	330	µg/Kg
Naphthalene	ND	330	µg/Kg
4-Chloroaniline	ND	330	µg/Kg
Hexachlorobutadiene	ND	330	µg/Kg
4-Chloro-3-Methylphenol	ND	330	µg/Kg
2-Methylnaphthalene	ND	330	µg/Kg
Hexachlorocyclopentadiene	ND	330	µg/Kg
2,4,6-Trichlorophenol	ND	330	µg/Kg
2,4,5-Trichlorophenol	ND	800	µg/Kg
2-Chloronaphthalene	ND	330	µg/Kg
2-Nitroaniline	ND	800	µg/Kg
Dimethyl Phthalate	ND	330	µg/Kg
Acenaphthylene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: 930709SNB1
Batch: EX930709000001

Reported on: 07/15/93 11:5
Analyzed on: 07/12/93 12:4
Analyst: LH

Compound	Result	Detection Limit	Units
3-Nitroaniline	ND	800	µg/Kg
Acenaphthene	ND	330	µg/Kg
2,4-Dinitrophenol	ND	800	µg/Kg
4-Nitrophenol	ND	800	µg/Kg
Dibenzofuran	ND	330	µg/Kg
2,4-Dinitrotoluene	ND	330	µg/Kg
2,6-Dinitrotoluene	ND	330	µg/Kg
Diethylphthalate	ND	330	µg/Kg
4-Chlorophenylphenyl ether	ND	330	µg/Kg
Fluorene	ND	330	µg/Kg
4-Nitroaniline	ND	800	µg/Kg
4,6-Dinitro-2-Methylphenol	ND	800	µg/Kg
N-Nitrosodiphenylamine (1)	ND	330	µg/Kg
1,2-Diphenylhydrazine	ND	330	µg/Kg
4-Bromophenylphenyl ether	ND	330	µg/Kg
Hexachlorobenzene	ND	330	µg/Kg
Pentachlorophenol	ND	800	µg/Kg
Phenanthrene	ND	330	µg/Kg
Anthracene	ND	330	µg/Kg
Carbazole	ND	330	µg/Kg
Di-n-Butylphthalate	ND	330	µg/Kg
Fluoranthene	ND	330	µg/Kg
Pyrene	ND	330	µg/Kg
Butylbenzylphthalate	ND	330	µg/Kg
3,3'-Dichlorobenzidine	ND	330	µg/Kg
Benzo(a)anthracene	ND	330	µg/Kg
Chrysene	ND	330	µg/Kg
bis(2-Ethylhexyl)Phthalate	ND	330	µg/Kg
Di-n-Octyl Phthalate	ND	330	µg/Kg
Benzo(b)fluoranthene	ND	330	µg/Kg
Benzo(k)fluoranthene	ND	330	µg/Kg
Benzo(a)pyrene	ND	330	µg/Kg
Indeno(1,2,3-cd)pyrene	ND	330	µg/Kg
Dibenz(a,h)anthracene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

Matrix: Soil
Sample ID: 930709SNB1
Batch: EX930709000001

Reported on: 07/15/93 11:
Analyzed on: 07/12/93 12:
Analyst: LH

Compound	Result	Detection Limit	Units
Benzo(g,h,i)perylene	ND	330	µg/Kg

Surrogate	Result	QC Criteria	Units
Nitrobenzene-d5	89	23-120	% Recovery
2-Fluorobiphenyl	84	30-115	% Recovery
Terphenyl-d14	98	18-137	% Recovery
Phenol-d5	87	24-113	% Recovery
2-Fluorophenol	93	25-121	% Recovery
2,4,6-Tribromophenol	92	19-122	% Recovery

Samples in Batch 9307161-01

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code MOISEP Date 7-9-93 Analyst DSE

Method GRAVIMETRIC Time 10:00AM Matrix SOIL

Of Samples in Set 50 Detection Limit 1

Sample #'s in Set 307223-1A,2A; 307161-1C; 307252-1A→6A; 307253-1A→3A; 307084-1E→3E; 307137-1B→6B; 307191-2B,3B,5B,7B; 307263-2B; 307256-5F; 307145-1B→8B; 307138-1B,3B,5B; 307247-1A→7A; 307263-4B,6B→9B Units %WEIGHT

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank						
#1						
#2						
#3						
#4						
Check Std.						

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
307137-6B	16	17	6.1	30.4	22.4	
307138-5B	22	25	12.8	↓	↓	
307191-7B	17	16	6.1			
307247-7A	88	88	0			
307252-6A	16	15	6.5			

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit

Spike Recovery Calculation

$$\%\ \text{Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Approved By Maria H Villarreal

Date 7/9/93

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Approved By Neil Chubb

Date 7/9/93

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 7/16/93 TIME: 09:29 AM. ANALYST: RQ. MATRIX: Soil
INSTRUMENT: TJA 61E FILE #: A0716 METHOD: ICP UNITS: mg/L.

SAMPLE ID NUMBERS: 7145 1B-8B 7161 1C, 7191 2B, 3B, 5B, 7B, 7137 1B-6B

QC SAMPLE ID: 1). 7191 7B 2).

ELEMENT	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
AL	ND	71.2	36.22	22.98	** 45	10.0	93.6	86.4	8
Cu	↓	84.6	0.01	ND	N/A	0.25	92.3	88.4	4
ZN	↓	83.9	0.0291	ND	↓	0.50	90.8	84.3	7
Ni	↓	90.45	ND	ND	↓	0.50	96.5	95.0	2
BA	↓	87.2	0.6095	0.5821	5	2.0	96.0	90.3	6
PB	↓	84.4	ND	ND	N/A	0.50	97.9	102.5	5
Be	↓	86.0	ND	ND	↓	0.05	103.0	100.4	3
SB	↓	101.5	ND	ND	↓	1.0	102.0	98.2	4
Cd	↓	90.1	ND	ND	↓	0.05	81.2	77.6	5
Ag	↓	96.8	ND	ND	↓	0.05	102.2	94.0	8
CR	↓	75.5	0.0445	0.0326	↓	0.20	94.0	85.6	9

FLAGS: **See case narrative *Analytical spike

SUPERVISOR APPROVAL: Meuga Nariam
DATE: 7/16/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/14/93 TIME: 07:18 ANALYST: WF MATRIX: Soil
INSTRUMENT: 30302 FILE #: 0714A METHOD ~~GFAA~~ UNITS: mg/kg

ELEMENT: AS

SAMPLE ID NUMBERS: 07143-1B-8B; 07137-1B-6B; 07161-1a.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07137-1B	ND	107.5%	ND	ND	NA	40.0	114.9%	101.5%	12
07137-3B	ND	119.9%	ND	10.6	NA	40.0	105.9%	105.9%	0

FLAGS:

SUPERVISOR APPROVAL: Maya Marian
DATE: 7/14/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code CRHEX Date 7-12-93 Analyst DAM

Method HACH Time 10:00am Matrix PRSOL

No. Of Samples in Set 1 Detection Limit 0.01

Sample #'s in Set 30716 1-IC Units mg/Kg

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank		ND	ND	ND		
#1						
#2						
#3						
#4						
Check Std.		0.097	0.10	97	INSUFF	DATA

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
7161-K	ND	ND	NA	INSUFF	DATA	

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
7161-IC	ND	0.10	0.097	0.097	97	INSUFF	DATA

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Yasmin Nahvi

Date 7-12-93

Approved By Cecil Chubb

Date 7/12/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/9/93 TIME: 14:29 ANALYST: Jm MATRIX: soil
INSTRUMENT: B3030 FILE #: 0709A METHOD: CVAA UNITS: ug/L

ELEMENT: Hg

SAMPLE ID NUMBERS: 7097-2A ; 7100-1B, 2B, 4B-6B, 8B-10B ; 7137-1B-6B ; 7145-1B-8B ; 7161-1C

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
7100-1B	ND	105.0	ND	ND	N/A	2.00	108.5	112.5	4
7145-8B	ND	102.6	↓	↓	↓	↓	108.5	116.5	7

FLAGS:

SUPERVISOR APPROVAL: Meaza Mariam
DATE: 7/9/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/14/93 TIME: 11:14 ANALYST: WF MATRIX: soil
INSTRUMENT: 3030Z FILE #: 0714B METHOD: ~~GFAA~~ UNITS: mg/kg

ELEMENT: SE

SAMPLE ID NUMBERS: 07145-1B-8B; 07137-1B-6B; 0716C-1C.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07137-3B	ND	111.4%	ND	ND	NA	30.0	101.0%	103.7%	3
PB7/12	ND	105.5%				30.0			

FLAGS: QC samples were analytically spiked

SUPERVISOR APPROVAL: Neeta Narian
DATE: 9/14/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code TOCS
Method 415.1
Of Samples in Set 1

Date 7.13.93
Time 4:05 PM

Analyst DAM
Matrix PRPTOC
Detection Limit 1

Sample #'s in Set 307161 - 1E

Units mg/kg

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank		ND	ND	NA		
#1		10.16	10.0	101.6	108.94	92.42
#2		50.11	50.0	100.2	↓	↓
#3		99.36	100.0	99.4		
#4		199.6	200.0	99.8		
Check Std.		40.89	41.0	99.7	45.1	36.9

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
7161-1E	337	337	0	11.0	8.1	1

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
7161-1E	33.7	40.0	73.62	39.92	99.8	120.1	70.8

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By Maria G Villarreal

Date 7/14/93

Approved By [signature]

Date 7/14/93

QUALITY CONTROL REPORT

SAMPLE ID: 9307161
DATE: 07/15/93
ANALYST: NDRC

METHOD

EPA 8330

COMPOUND	BLANK mg/Kg	SPIKE % RECOVERY	MS/MSD RPD	LCS RECOVERY	DUPLICATE RPD
RDX	< 1.0	85.0	0	85.0	---
DNB	< 0.25	79.5	1.3	79.0	---
2,4-DNT	< 0.25	79.5	1.3	80.0	---

ND = Parameter was analyzed for but not detected.

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

Page of

SPL ENVIRONMENTAL LABORATORIES, INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02211.01	Civic Group Inc./Calfax R&D	Calfax LA

Field Sample No./Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	ANALYSIS REQUESTED METHOD	LABORATORY REMARKS
P-2S@4'	6/29/93 1300	X			Soil	Ice	Volitiles		
P-2S@4'	" 1300	X			Soil	Ice	Semi Volitiles		
P-2S@4'	" 1300	X			Soil	Ice	HPLC		
P-2S@4'	" 1300	X			Soil	Ice	Metals/Organic C		

Samplers (Signature)	Relinquished by: (Signature)	Date: Time:	Received by: (Signature)	Date: Time:	Intact
Alan Prechocka	Alan Prechocka	Date: 7/5/93 Time: 2000	Mary Jo Prechocka	Date: 7/5/93 Time: 8:15 PM	
	Relinquished by (Signature) Mary Jo Prechocka	Date: 7/7/93 Time: 2:36	Received by: (Signature)	Date: 7/7/93 Time: 2:56	Intact ✓
Affiliation: Civic Group Inc.	Relinquished by: (Signature)	Date: Time:	Received by: (Signature)	Date: 7/7/93 Time: 8:05	Intact ✓ 4°C

REPORT TO:

SPL HOUSTON ENVIRONMENTAL LABORATORY

SAMPLE LOGIN CHECKLIST

DATE: 7/7 TIME: 8:05 CLIENT NO. _____
LOT NO. 1 CONTRACT NO. _____

CLIENT SAMPLE NOS. _____

SPL SAMPLE NOS.: 9307161

		YES	NO
1.	Is a Chain-of-Custody form present?	✓	
2.	Is the COC properly completed?	✓	
	If no, describe what is incomplete:		
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
3.	Is airbill/packing list/bill of lading with shipment?		✓
	If yes, ID#: By John Troost		
4.	Is a USEPA Traffic Report present?		✓
5.	Is a USEPA SAS Packing List present?		✓
6.	Are custody seals present on the package?		✓
	If yes, were they intact upon receipt?		
7.	Are all samples tagged or labeled?	✓	
	Do the sample tags/labels match the COC?	✓	
	If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
8.	Do all shipping documents agree?	✓	
	If no, describe what is in nonconformity:		

9. Condition/temperature of shipping container: INTACT 4°C
10. Condition/temperature of sample bottles: GOOD 4°C
11. Sample Disposal?: SPL disposal ✓ Return to client ____

NOTES (reference item number if applicable): _____

ATTEST: _____ DATE: 7/7/93
DELIVERED FOR RESOLUTION: REC'D _____ DATE: _____
RESOLVED: _____ DATE: _____

QUALITY CONTROL DOCUMENTATION

SOIL VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307645 SAS No.: _____ SDG No.: 307645

Level: (low/med) LOW

	EPA SAMPLE NO.	SMC1 (TOL)#	SMC2 (BFB)#	SMC3 (DCE)#	OTHER	TOT OUT
01	MW-2-S_4_	95	99	84	0	0
02	VSBLK01	98	94	85	0	0

		QC LIMITS
SMC1 (TOL)	= Toluene-d8	(84-138)
SMC2 (BFB)	= Bromofluorobenzene	(59-113)
SMC3 (DCE)	= 1,2-Dichloroethane-d4	(70-121)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: _____ Case No.: BLANK SAS No.: _____ SDG No.: 307645

Matrix Spike - EPA Sample No.: VSBLK01 Level:(low/med) LOW

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50.00	0	56.80	114	59-172
Trichloroethene	50.00	0	56.60	113	62-137
Benzene	50.00	0	48.40	97	66-142
Toluene	50.00	0	52.80	106	59-139
Chlorobenzene	50.00	0	53.50	107	60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50.00	55.00	110	4	22	59-172
Trichloroethene	50.00	52.70	105	7	24	62-137
Benzene	50.00	54.80	110	13	21	66-142
Toluene	50.00	51.00	102	4	21	59-139
Chlorobenzene	50.00	50.20	100	7	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: SPL,BLANK,,VSBLK01,L,S,VSBLK010723A,V,B,5MLS,
PACK,0723VS2A1,0723BFA1,,,,,45/3-220@8,INST A,

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VSBLK01

b Name: SPLHOUSTON Contract: _____

b Code: SPL Case No.: 307645 SAS No.: _____ SDG No.: 307645

Lab File ID: 0725VSBA2 Lab Sample ID: VSBLK010725A

Date Analyzed: 07/25/93 Time Analyzed: 1137

GC Column: PACK ID: _____(mm) Heated Purge: (Y/N) Y

Instrument ID: A

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	MW-2-S_4_	9307645-01A	V764501A	1252

COMMENTS: SPL,BLANK,,VSBLK01,L,S,VSBLK010725A,V,B,5MLS,
PACK,0725VS2A2,0725BFA1,,,,,45/3-220@8,INST A,

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010725
Batch: VOA930725091200

Reported on: 07/27/93 13:
Analyzed on: 07/25/93 11:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Chloromethane	ND	10	µg/Kg
Bromomethane	ND	10	µg/Kg
Vinyl Chloride	ND	10	µg/Kg
Chloroethane	ND	10	µg/Kg
Methylene Chloride	ND	5	µg/Kg
Acetone	ND	10	µg/Kg
Carbon Disulfide	ND	5	µg/Kg
Trichlorofluoromethane	ND	5	µg/Kg
1,1-Dichloroethene	ND	5	µg/Kg
1,1-Dichloroethane	ND	5	µg/Kg
total-1,2-Dichloroethene	ND	5	µg/Kg
Chloroform	ND	5	µg/Kg
1,2-Dichloroethane	ND	5	µg/Kg
2-Butanone	ND	20	µg/Kg
1,1,1-Trichloroethane	ND	5	µg/Kg
Carbon Tetrachloride	ND	5	µg/Kg
Vinyl Acetate	ND	10	µg/Kg
Bromodichloromethane	ND	5	µg/Kg
1,2-Dichloropropane	ND	5	µg/Kg
Trichloroethene	ND	5	µg/Kg
Dibromochloromethane	ND	5	µg/Kg
1,1,2-Trichloroethane	ND	5	µg/Kg
Benzene	ND	5	µg/Kg
cis-1,3-Dichloropropene	ND	5	µg/Kg
trans-1,3-Dichloropropene	ND	5	µg/Kg
2-Chloroethylvinylether	ND	10	µg/Kg
Bromoform	ND	5	µg/Kg
4-Methyl-2-Pentanone	ND	10	µg/Kg
2-Hexanone	ND	10	µg/Kg
Tetrachloroethene	ND	5	µg/Kg
1,1,2,2-Tetrachloroethane	ND	5	µg/Kg
Toluene	ND	5	µg/Kg
Chlorobenzene	ND	5	µg/Kg
Ethylbenzene	ND	5	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: VSBLK010725
Batch: VOA930725091200

Reported on: 07/27/93 13:
Analyzed on: 07/25/93 11:
Analyst: GAB

Volatile Organics

Compound	Result	Detection Limit	Units
Styrene	ND	5	µg/Kg
Xylene (total)	ND	5	µg/Kg

Surrogate	Result	QC Criteria	Units
Toluene-d8	98	84-138	% Recovery
4-Bromofluorobenzene	94	59-113	% Recovery
1,2-Dichloroethane-d4	85	70-121	% Recovery

Samples in Batch 9307645-01

Notes

ND - Not detected.

Cynthia Schreiner, QC Officer

SOIL SEMIVOLATILE SURROGATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307645 SAS No.: _____ SDG No.: 307645

Level:(low/med) LOW

	EPA SAMPLE NO.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#	S7 (2CP)#	S8 (DCB)#	TOT OUT
01	MW-2-S_4_	75	77	102	82	100	78	90	81	0
02	SBLK03	86	79	85	83	94	88	84	82	0

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(23-120)	
S2 (FBP)	= 2-Fluorobiphenyl	(30-115)	
S3 (TPH)	= Terphenyl-d14	(18-137)	
S4 (PHL)	= Phenol-d5	(24-113)	
S5 (2FP)	= 2-Fluorophenol	(25-121)	
S6 (TBP)	= 2,4,6-Tribromophenol	(19-122)	
S7 (2CP)	= 2-Chlorophenol-d4	(20-130)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(20-130)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

SBLK03

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307645 SAS No.: _____ SDG No.: 307645

Lab File ID: E4467 Lab Sample ID: 930723SNB1

Instrument ID: E Date Extracted: 07/23/93

Matrix: (soil/water) SOIL Date Analyzed: 07/28/93

Level: (low/med) LOW Time Analyzed: 1859

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	MW-2-S_4_	9307645-01B	B764501	07/28/93

COMMENTS: ,BLANK,,SBLK03,L,S,930723SNB1,B,B,C,E,
C,E4456,E4455,,,,,,E

SPL Blank QC Report

Matrix: Soil
Sample ID: 930723SNB1
Batch: EX930723000001

Reported on: 07/31/93 19:(
Analyzed on: 07/28/93 18:
Analyst: LH

Compound	Result	Detection Limit	Units
Pyridine	ND	330	µg/Kg
Phenol	ND	330	µg/Kg
Aniline	ND	330	µg/Kg
bis(2-Chloroethyl)Ether	ND	330	µg/Kg
2-Chlorophenol	ND	330	µg/Kg
1,3-Dichlorobenzene	ND	330	µg/Kg
1,4-Dichlorobenzene	ND	330	µg/Kg
Benzyl Alcohol	ND	330	µg/Kg
1,2-Dichlorobenzene	ND	330	µg/Kg
2-Methylphenol	ND	330	µg/Kg
bis(2-Chloroisopropyl)Ethe	ND	330	µg/Kg
4-Methylphenol	ND	330	µg/Kg
N-Nitroso-Di-n-Propylamine	ND	330	µg/Kg
Hexachloroethane	ND	330	µg/Kg
Nitrobenzene	ND	330	µg/Kg
Isophorone	ND	330	µg/Kg
2-Nitrophenol	ND	330	µg/Kg
2,4-Dimethylphenol	ND	330	µg/Kg
Benzoic Acid	ND	1600	µg/Kg
bis(2-Chloroethoxy)Methane	ND	330	µg/Kg
2,4-Dichlorophenol	ND	330	µg/Kg
1,2,4-Trichlorobenzene	ND	330	µg/Kg
Naphthalene	ND	330	µg/Kg
4-Chloroaniline	ND	330	µg/Kg
Hexachlorobutadiene	ND	330	µg/Kg
4-Chloro-3-Methylphenol	ND	330	µg/Kg
2-Methylnaphthalene	ND	330	µg/Kg
Hexachlorocyclopentadiene	ND	330	µg/Kg
2,4,6-Trichlorophenol	ND	330	µg/Kg
2,4,5-Trichlorophenol	ND	800	µg/Kg
2-Chloronaphthalene	ND	330	µg/Kg
2-Nitroaniline	ND	800	µg/Kg
Dimethyl Phthalate	ND	330	µg/Kg
Acenaphthylene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: 930723SNB1
Batch: EX930723000001

Reported on: 07/31/93 19:
Analyzed on: 07/28/93 18:
Analyst: LH

Compound	Result	Detection Limit	Units
3-Nitroaniline	ND	800	µg/Kg
Acenaphthene	ND	330	µg/Kg
2,4-Dinitrophenol	ND	800	µg/Kg
4-Nitrophenol	ND	800	µg/Kg
Dibenzofuran	ND	330	µg/Kg
2,4-Dinitrotoluene	ND	330	µg/Kg
2,6-Dinitrotoluene	ND	330	µg/Kg
Diethylphthalate	ND	330	µg/Kg
4-Chlorophenylphenyl ether	ND	330	µg/Kg
Fluorene	ND	330	µg/Kg
4-Nitroaniline	ND	800	µg/Kg
4,6-Dinitro-2-Methylphenol	ND	800	µg/Kg
N-Nitrosodiphenylamine (1)	ND	330	µg/Kg
1,2-Diphenylhydrazine	ND	330	µg/Kg
4-Bromophenylphenyl ether	ND	330	µg/Kg
Hexachlorobenzene	ND	330	µg/Kg
Pentachlorophenol	ND	800	µg/Kg
Phenanthrene	ND	330	µg/Kg
Anthracene	ND	330	µg/Kg
Carbazole	ND	330	µg/Kg
Di-n-Butylphthalate	ND	330	µg/Kg
Fluoranthene	ND	330	µg/Kg
Pyrene	ND	330	µg/Kg
Butylbenzylphthalate	ND	330	µg/Kg
3,3'-Dichlorobenzidine	ND	330	µg/Kg
Benzo(a)anthracene	ND	330	µg/Kg
Chrysene	ND	330	µg/Kg
bis(2-Ethylhexyl)Phthalate	ND	330	µg/Kg
Di-n-Octyl Phthalate	ND	330	µg/Kg
Benzo(b)fluoranthene	ND	330	µg/Kg
Benzo(k)fluoranthene	ND	330	µg/Kg
Benzo(a)pyrene	ND	330	µg/Kg
Indeno(1,2,3-cd)pyrene	ND	330	µg/Kg
Dibenz(a,h)anthracene	ND	330	µg/Kg

Notes
ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Soil
Sample ID: 930723SNB1
Batch: EX930723000001

Reported on: 07/31/93 19:(
Analyzed on: 07/28/93 18:
Analyst: LH

Compound	Result	Detection Limit	Units
Benzo(g,h,i)perylene	ND	330	µg/Kg

Surrogate	Result	QC Criteria	Units
Nitrobenzene-d5	86	23-120	% Recovery
2-Fluorobiphenyl	79	30-115	% Recovery
Terphenyl-d14	85	18-137	% Recovery
Phenol-d5	83	24-113	% Recovery
2-Fluorophenol	94	25-121	% Recovery
2,4,6-Tribromophenol	88	19-122	% Recovery

Samples in Batch 9307645-01

Notes

ND - Not detected.

Cynthia Schreiner

Cynthia Schreiner, QC Officer

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code MOISEP / MOISV Date 7/22/93 Analyst KEW

Method D2216-80 (GRAVIMETRIC) Time 10:30am Matrix SOIL

Of Samples in Set 4 Detection Limit 1

Sample #'s in Set: 307656-4C; 307645-1B; 307534-8A, 9A Units % WEIGHT

Standards	EM, %T, ABS.	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank						
#1						
#2						
#3						
#4						
Check Std.						

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
307656-4C	14	14	0	RPD 30.4	22.4	
7534-8A	32	32	0	30.4	22.4	

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
NA							

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By [signature] Date 7/23/93

Approved By [signature] Date 7/23/93

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 7/23/93 TIME: 10:41 AM. ANALYST: AR. MATRIX: Soil
INSTRUMENT: TJA 616 FILE #: A0728 METHOD: ICP UNITS: mg/L.

SAMPLE ID NUMBERS: 7828 10A - 12A, 7847 1c - 5c 7645 1d, 7763 1A
7766 5A

QC SAMPLE ID: 1). 7847 3c 2).

ELEMENT PB 7/27	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
~~PB~~	NP	—	~~NP~~	~~NP~~	—	—	—	—	—
AL		93.6	31.24	16.85	60 *	0.2	93.3	90.0	4
Cu		87.5	0.0325	0.0325	N/A	0.25	98.4	96.8	2
ZN		85.5	0.1331	0.1128	17	0.50	91.1	92.8	2
Cd		90.8	NP	NP	N/A	0.05	75.4	78.4	4
BA		91.7	0.3904	0.3328	16	2.0	97.8	101.1	3
Ni		87.9	NP	NP	N/A	0.50	95.2	97.8	3
Be		88.3	NP	NP		0.05	102.2	102.2	0
~~PB~~ PB		87.3	0.1303	0.1250		0.50	102.4	99.1	3
AG		124.5	NP	NP		1.0	101.3	95.6	6
AG		97.1	NP	NP		0.05	106.2	104.4	2
CR	✓	82.3	0.0534	0.0303	✓	0.20	~~112~~ 52	85.8	3
PB 7/26							88.0		
AL	NP	62.3							
Cu		88.7							
ZN		86.8							
Cd		95.0							
BA		90.7							
Ni		88.3							
Be		91.6							
AG		90.0							
~~SB~~ SB	✓	93.7							

FLAGS: ~~* Analyte not spiked~~ ~~* See case narrative~~ * post digestion spike

SUPERVISOR APPROVAL: Meaga Marion
DATE: 7/29/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/27/93 TIME: 10:45 ANALYST: WF MATRIX: Soil
INSTRUMENT: 3030Z FILE #: 0727B METHOD: ~~GFAA~~ UNITS: mg/kg

ELEMENT: AS

SAMPLE ID NUMBERS: 07645-1D; 07707-1c-2c; 07766-5D; 07801-1D, 3D-8D.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07801-1D	ND	61.6%	18.2	18.0	~~NA~~ 1	40.0	87.5%	86.5%	1

FLAGS:

SUPERVISOR APPROVAL: Neeza Narian
DATE: 7/27/93

8880 Interchange Drive, Houston, Texas 77054 713/660-0901

Wet Chemistry QA/QC Validation Report

Test Code CRHEX
Method HACH
Of Samples in Set 1

Date 7.29.93
Time 9:30am

Analyst KEW
Matrix LIQUID
Detection Limit 0.01

Units mg/L

Sample #'s in Set				
		9307645-1D		

Standards	EM, %T, (ABS.)	Actual Concentration	Theoretical Concentration	% Recovery	Upper Limit	Lower Limit
Blank	0.000	ND	ND	NA	NA	NA
#1 0.05 mg/L STD	0.397	0.049	0.050	98.0	INSUFFICENT	DATA
#2						
#3						
#4						
Check Std.	0.760	KEW ~~0.10~~ 0.095	0.10	95.0	INSUFFICENT	DATA

Duplicate	#1	#2	RPD (%)	Upper Limit	Lower Limit	Dilution
307645-1D	NA	NA	0	INSUFFICENT	DATA	

Spike Sample	Concentration Before Spike	Amount Added	Concentration After Spike	After - Before	% Recovery	Upper Limit	Lower Limit
307645-1D	ND (24.5/50)	0.10	0.096	0.096	KEW 96.0	INSUFFICENT	DATA

Spike Recovery Calculation

$$\% \text{ Recovery} = \frac{(\text{Actual} - \text{Original})}{\text{Amount Added}} \times 100$$

Relative Percent Difference Calculation

$$\text{RPD} = \frac{(\#1 - \#2)}{(\#1 + \#2)(0.5)} \times 100$$

Reviewed By [signature]

Date 7/29/93

Approved By Marie A Villarreal

Date 7/29/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/27/93 TIME: 9:21 ANALYST: JM MATRIX: soil
INSTRUMENT: B3030 FILE #: 0727A METHOD: CVAA UNITS: ug/L

ELEMENT: Hg

SAMPLE ID NUMBERS: 7645-1D ; 7707-1C, 2C ; 7735-1A-17A

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
7735-1A	ND	116.8	ND	ND	N/A	2.00	112.5	112.5	0

FLAGS:

SUPERVISOR APPROVAL: Meaza Mariam
DATE: 7/27/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/27/93 TIME: 08:29 ANALYST: WFC MATRIX: Soil
INSTRUMENT: 30302 FILE #: 0727A METHOD: GFAA UNITS: mg/kg

ELEMENT: SE

SAMPLE ID NUMBERS: 07645-1D; 07707-1C-2C; 07766-5A; 07801-1D, 3D-8D.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07801-1D	NS	86.0%	NS	NS	NA	30.0	80.0%	81.0%	1

FLAGS:

SUPERVISOR APPROVAL: Neaga Mariam
DATE: 7/27/93

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

9307693 7/18 p.i

SPL ENVIRONMENTAL LABORATORIES, INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

9307514

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02011.01	Viro Group Inc / R+D Colfax	Colfax LA

Field Sample No / Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	ANALYSIS REQUESTED METHOD	LABORATORY REMARKS 8/3
MW2-SE4'	7/13/93 0900	X			Soil	Ice	Volitile		82405
MW2-SE4'	"	X			Soil	Ice	Semi Volitile		82705
MW2-SE4'	"	X			Soil	Ice	HPLC		83505 (OSHO)
MW2-SE4'	"	X			Soil	Ice	Metals		RCRA-1

Samplers (Signature)	Relinquished by: (Signature)	Date: / Time:	Received by: (Signature)	Date: / Time:	Intact
Alan Pruchocki	Alan Pruchocki	Date: 7/18/93 Time: 2000		Date: Time:	
	Relinquished by: (Signature) Mary Jo Pruchocki	Date: 7/19/93 Time: 2:3	Received by: (Signature) George Rich	Date: Time:	Intact
Affiliation: Viro Group Inc.	Relinquished by: (Signature)	Date: Time:	Received by: (Signature) [illegible]	Date: 7-19-93 Time: 16:05	Intact

REPORT TO:

[illegible] (SPL-Hou) 7/23 09:00 42

SPL HOUSTON ENVIRONMENTAL LABORATORY

SAMPLE LOGIN CHECKLIST

DATE: 7/23/93 TIME: 09:00 CLIENT NO. _____
LOT NO. _____ CONTRACT NO. _____

CLIENT SAMPLE NOS. _____

SPL SAMPLE NOS.: _____

	YES	NO
1. Is a Chain-of-Custody form present?	✓	
2. Is the COC properly completed?	✓	
If no, describe what is incomplete:		
If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
3. Is airbill/packing list/bill of lading with shipment?	✓	
If yes, ID#: Fax		
4. Is a USEPA Traffic Report present?		✓
5. Is a USEPA SAS Packing List present?		✓
6. Are custody seals present on the package?		✓
If yes, were they intact upon receipt?		
7. Are all samples tagged or labeled?	✓	
Do the sample tags/labels match the COC?	✓	
If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
8. Do all shipping documents agree?		
If no, describe what is in nonconformity:		

9. Condition/temperature of shipping container: INTACT 4°C
10. Condition/temperature of sample bottles: ✓ 00-0-4°C
11. Sample Disposal?: SPL disposal _____ Return to client _____

NOTES (reference item number if applicable): _____

ATTEST: _____ DATE: 7/23/93
DELIVERED FOR RESOLUTION: REC'D _____ DATE: _____
RESOLVED: _____ DATE: _____

QUALITY CONTROL DOCUMENTATION

WATER VOLATILE SYSTEM MONITORING COMPOUND RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307752 SAS No.: _____ SDG No.: 307752

	EPA SAMPLE NO.	SMC1 (TOL)#	SMC2 (BFB)#	SMC3 (DCE)#	OTHER	TOT OUT
01	MW1-W1	101	103	106	0	0
02	MW2-W1	104	97	102	0	0
03	P1-W1	103	96	104	0	0
04	P2-W1	100	100	106	0	0
05	P3-W1	107	99	104	0	0
06	TRIP_BLANK	104	95	108	0	0
07	VBLK01	101	98	105	0	0
08	VBLK01	102	98	98	0	0

	QC LIMITS
SMC1 (TOL) = Toluene-d8	(88-110)
SMC2 (BFB) = Bromofluorobenzene	(86-115)
SMC3 (DCE) = 1,2-Dichloroethane-d4	(76-114)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307606 SAS No.: _____ SDG No.: 307752

Matrix Spike - EPA Sample No.: SB-3

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50.00	0	57.00	114	61-145
Trichloroethene	50.00	0	47.70	95	71-120
Benzene	50.00	0	52.20	104	76-127
Toluene	50.00	0	53.70	107	76-125
Chlorobenzene	50.00	0	52.20	104	75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50.00	58.00	116	2	14	61-145
Trichloroethene	50.00	48.00	96	1	14	71-120
Benzene	50.00	53.30	107	3	11	76-127
Toluene	50.00	55.00	110	3	13	76-125
Chlorobenzene	50.00	52.00	104	0	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: BTEXVW,307606,,SB-3,L,W,9307606-01A,V,E,5.0 MLS,
PACK,0725VL2B2,0725BFB2,0725VLBB3,,,,45/3-220@8,INST B,

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307752 SAS No.: _____ SDG No.: 307752

Lab File ID: 0726VLBB1 Lab Sample ID: VLBLK010726B

Date Analyzed: 07/26/93 Time Analyzed: 1202

GC Column: PACK ID: 2.00(mm) Heated Purge: (Y/N) N

Instrument ID: B1

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	MW1-W1	9307752-03A	V775203	2314
02	P1-W1	9307752-01A	V775201	2155
03	P2-W1	9307752-02A	V775202	2235
04	TRIP_BLANK	9307752-06A	V775206	2116

COMMENTS: SPLINC,BLANK,,VBLK01,L,W,VLBLK010726B,V,B,
PACK,0726VL2B1,0726BFB1,0726VLBB1,,,,45/3-220@8,INST B,

SPL Blank QC Report

Matrix: Aqueous
Sample ID: VLBLK010726
Batch: VOB930726115000

Reported on: 07/29/93 13:3
Analyzed on: 07/26/93 12:0
Analyst: JC

Volatile Organics

Compound	Result	Detection Limit	Units
Chloromethane	ND	10	µg/L
Bromomethane	ND	10	µg/L
Vinyl Chloride	ND	10	µg/L
Chloroethane	ND	10	µg/L
Methylene Chloride	ND	5	µg/L
Acetone	12	10	µg/L
Carbon Disulfide	ND	5	µg/L
Trichlorofluoromethane	ND	5	µg/L
1,1-Dichloroethene	ND	5	µg/L
1,1-Dichloroethane	ND	5	µg/L
total-1,2-Dichloroethene	ND	5	µg/L
Chloroform	ND	5	µg/L
1,2-Dichloroethane	ND	5	µg/L
2-Butanone	ND	20	µg/L
1,1,1-Trichloroethane	ND	5	µg/L
Carbon Tetrachloride	ND	5	µg/L
Vinyl Acetate	ND	10	µg/L
Bromodichloromethane	ND	5	µg/L
1,2-Dichloropropane	ND	5	µg/L
Trichloroethene	ND	5	µg/L
Dibromochloromethane	ND	5	µg/L
1,1,2-Trichloroethane	ND	5	µg/L
Benzene	ND	5	µg/L
cis-1,3-Dichloropropene	ND	5	µg/L
trans-1,3-Dichloropropene	ND	5	µg/L
2-Chloroethylvinylether	ND	10	µg/L
Bromoform	ND	5	µg/L
4-Methyl-2-Pentanone	ND	10	µg/L
2-Hexanone	ND	10	µg/L
Tetrachloroethene	ND	5	µg/L
1,1,2,2-Tetrachloroethane	ND	5	µg/L
Toluene	ND	5	µg/L
Chlorobenzene	ND	5	µg/L
Ethylbenzene	ND	5	µg/L

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Aqueous
Sample ID: VLBLK010726
Batch: VOB930726115000

Reported on: 07/29/93 13:3
Analyzed on: 07/26/93 12:0
Analyst: JC

Volatile Organics

Compound	Result	Detection Limit	Units
Styrene	ND	5	µg/L
Xylene (total)	ND	5	µg/L

Surrogate	Result	QC Criteria	Units
Toluene-d8	101	88-110	% Recovery
4-Bromofluorobenzene	98	86-115	% Recovery
1,2-Dichloroethane-d4	105	76-114	% Recovery

Samples in Batch 9307752-01 9307752-02 9307752-03 9307752-06

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

4A

VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

VBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307752 SAS No.: _____ SDG No.: 307752

Lab File ID: 0727VLBB1 Lab Sample ID: VLBLK010727B

Date Analyzed: 07/27/93 Time Analyzed: 1106

GC Column: PACK ID: _____(mm) Heated Purge: (Y/N) N

Instrument ID: B1

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	MW2-W1	9307752-04A	V775204	1346
02	P3-W1	9307752-05A	V775205	1425

COMMENTS: SPLINC,BLANK,,VBLK01,L,W,VLBLK010727B,V,B,
PACK,0727VL2B1,0727BFB1,0727VLBB1,,,,45/3-220@8,INST B,

SPL Blank QC Report

Matrix: Aqueous
Sample ID: VLBLK010727
Batch: VOB930727101400

Reported on: 07/29/93 13:
Analyzed on: 07/27/93 11:
Analyst: JC

Volatile Organics

Compound	Result	Detection Limit	Units
Styrene	ND	5	µg/L
Xylene (total)	ND	5	µg/L

Surrogate	Result	QC Criteria	Units
Toluene-d8	102	88-110	% Recovery
4-Bromofluorobenzene	98	86-115	% Recovery
1,2-Dichloroethane-d4	98	76-114	% Recovery

Samples in Batch 9307752-04 9307752-05

Notes

ND - Not detected.

Cynthia Schreiner, QC Officer

2C

WATER SEMIVOLATILE SURROGATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307752 SAS No.: _____ SDG No.: 307752

	EPA SAMPLE NO.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#	S7 (2CP)#	S8 (DCB)#	TOT OUT
01	MW1-W1	73	74	93	74	79	93	78	66	0
02	MW2-W1	77	79	110	72	79	89	78	64	0
03	P1-W1	67	81	105	72	83	90	81	69	0
04	P2-W1	69	83	85	74	87	88	80	67	0
05	P3-W1	73	74	87	69	70	91	73	66	0
06	SBLK01	103	87	96	83	92	89	92	73	0

		QC LIMITS	
S1 (NBZ)	= Nitrobenzene-d5	(35-114)	
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)	
S3 (TPH)	= Terphenyl-d14	(33-141)	
S4 (PHL)	= Phenol-d5	(10-110)	
S5 (2FP)	= 2-Fluorophenol	(21-110)	
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)	
S7 (2CP)	= 2-Chlorophenol-d4	(33-110)	(advisory)
S8 (DCB)	= 1,2-Dichlorobenzene-d4	(16-110)	(advisory)

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate diluted out

3C

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: SPLHOUSTON Contract: _____

Lab Code: _____ Case No.: BLANK SAS No.: _____ SDG No.: 307752

Matrix Spike - EPA Sample No.: SBLK01

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
Phenol	75.00	0	49.40	66	12-110
2-Chlorophenol	75.00	0	51.20	68	27-123
1,4-Dichlorobenzene	50.00	0	27.20	54	36- 97
N-Nitroso-di-n-prop.(1)	50.00	0	32.20	64	41-116
1,2,4-Trichlorobenzene	50.00	0	29.20	58	39- 98
4-Chloro-3-methylphenol	75.00	0	53.60	71	23- 97
Acenaphthene	50.00	0	34.60	69	46-118
4-Nitrophenol	75.00	0	42.80	57	10- 80
2,4-Dinitrotoluene	50.00	0	31.60	63	24- 96
Pentachlorophenol	75.00	0	54.80	73	9-103
Pyrene	50.00	0	26.80	54	26-127

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	75.00	47.00	63	5	42	12-110
2-Chlorophenol	75.00	48.40	65	5	40	27-123
1,4-Dichlorobenzene	50.00	26.00	52	4	28	36- 97
N-Nitroso-di-n-prop.(1)	50.00	30.60	61	5	38	41-116
1,2,4-Trichlorobenzene	50.00	28.80	58	0	28	39- 98
4-Chloro-3-methylphenol	75.00	52.00	69	3	42	23- 97
Acenaphthene	50.00	32.60	65	6	31	46-118
4-Nitrophenol	75.00	41.60	55	4	50	10- 80
2,4-Dinitrotoluene	50.00	31.00	62	2	38	24- 96
Pentachlorophenol	75.00	51.60	69	6	50	9-103
Pyrene	50.00	25.60	51	6	31	26-127

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: ,BLANK,,SBLK01,L,W,930726CXB1,B,B,C,E,
C,E4499,E4498,,,,,,E

4B

SEMIVOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.

SBLK01

Lab Name: SPLHOUSTON Contract: _____

Lab Code: SPL Case No.: 307752 SAS No.: _____ SDG No.: 307752

Lab File ID: E4500 Lab Sample ID: 930726CXB1

Instrument ID: E Date Extracted: 07/26/93

Matrix: (soil/water) WATER Date Analyzed: 07/30/93

Level: (low/med) LOW Time Analyzed: 1459

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	MW1-W1	9307752-03B	B775203	08/05/93
02	MW2-W1	9307752-04B	B775204	08/05/93
03	P1-W1	9307752-01B	B775201	08/04/93
04	P2-W1	9307752-02B	B775202	08/04/93
05	P3-W1	9307752-05B	B775205	08/05/93

COMMENTS: ,BLANK,,SBLK01,L,W,930726CXB1,B,B,C,E,
C,E4499,E4498,,,,,,E

SPL Blank QC Report

Matrix: Aqueous
Sample ID: 930726CXB1
Batch: EX930726080000

Reported on: 08/06/93 16:
Analyzed on: 07/30/93 14:
Analyst: LH

Compound	Result	Detection Limit	Units
Pyridine	ND	5	µg/L
Phenol	ND	5	µg/L
Aniline	ND	5	µg/L
bis(2-Chloroethyl)Ether	ND	5	µg/L
2-Chlorophenol	ND	5	µg/L
1,3-Dichlorobenzene	ND	5	µg/L
1,4-Dichlorobenzene	ND	5	µg/L
Benzyl Alcohol	ND	5	µg/L
1,2-Dichlorobenzene	ND	5	µg/L
2-Methylphenol	ND	5	µg/L
bis(2-Chloroisopropyl)Ethe	ND	5	µg/L
4-Methylphenol	ND	5	µg/L
N-Nitroso-Di-n-Propylamine	ND	5	µg/L
Hexachloroethane	ND	5	µg/L
Nitrobenzene	ND	5	µg/L
Isophorone	ND	5	µg/L
2-Nitrophenol	ND	5	µg/L
2,4-Dimethylphenol	ND	5	µg/L
Benzoic Acid	ND	25	µg/L
bis(2-Chloroethoxy)Methane	ND	5	µg/L
2,4-Dichlorophenol	ND	5	µg/L
1,2,4-Trichlorobenzene	ND	5	µg/L
Naphthalene	ND	5	µg/L
4-Chloroaniline	ND	5	µg/L
Hexachlorobutadiene	ND	5	µg/L
4-Chloro-3-Methylphenol	ND	5	µg/L
2-Methylnaphthalene	ND	5	µg/L
Hexachlorocyclopentadiene	ND	5	µg/L
2,4,6-Trichlorophenol	ND	5	µg/L
2,4,5-Trichlorophenol	ND	10	µg/L
2-Chloronaphthalene	ND	5	µg/L
2-Nitroaniline	ND	25	µg/L
Dimethyl Phthalate	ND	5	µg/L
Acenaphthylene	ND	5	µg/L

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Aqueous
Sample ID: 930726CXB1
Batch: EX930726080000

Reported on: 08/06/93 16:
Analyzed on: 07/30/93 14:
Analyst: LH

Compound	Result	Detection Limit	Units
3-Nitroaniline	ND	25	µg/L
Acenaphthene	ND	5	µg/L
2,4-Dinitrophenol	ND	25	µg/L
4-Nitrophenol	ND	25	µg/L
Dibenzofuran	ND	5	µg/L
2,4-Dinitrotoluene	ND	5	µg/L
2,6-Dinitrotoluene	ND	5	µg/L
Diethylphthalate	ND	5	µg/L
4-Chlorophenylphenyl ether	ND	5	µg/L
Fluorene	ND	5	µg/L
4-Nitroaniline	ND	25	µg/L
4,6-Dinitro-2-Methylphenol	ND	25	µg/L
N-Nitrosodiphenylamine (1)	ND	5	µg/L
1,2-Diphenylhydrazine	ND	5	µg/L
4-Bromophenylphenyl ether	ND	5	µg/L
Hexachlorobenzene	ND	5	µg/L
Pentachlorophenol	ND	25	µg/L
Phenanthrene	ND	5	µg/L
Anthracene	ND	5	µg/L
Carbazole	ND	5	µg/L
Di-n-Butylphthalate	ND	5	µg/L
Fluoranthene	ND	5	µg/L
Pyrene	ND	5	µg/L
Butylbenzylphthalate	ND	5	µg/L
3,3'-Dichlorobenzidine	ND	5	µg/L
Benzo(a)anthracene	ND	5	µg/L
Chrysene	ND	5	µg/L
bis(2-Ethylhexyl)Phthalate	ND	5	µg/L
Di-n-Octyl Phthalate	ND	5	µg/L
Benzo(b)fluoranthene	ND	5	µg/L
Benzo(k)fluoranthene	ND	5	µg/L
Benzo(a)pyrene	ND	5	µg/L
Indeno(1,2,3-cd)pyrene	ND	5	µg/L
Dibenz(a,h)anthracene	ND	5	µg/L

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL Blank QC Report

Matrix: Aqueous
Sample ID: 930726CXB1
Batch: EX930726080000

Reported on: 08/06/93 16:(
Analyzed on: 07/30/93 14:
Analyst: LH

Compound	Result	Detection Limit	Units
Benzo(g,h,i)perylene	ND	5	µg/L

Surrogate	Result	QC Criteria	Units
Nitrobenzene-d5	103	35-114	% Recovery
2-Fluorobiphenyl	87	43-116	% Recovery
Terphenyl-d14	96	33-141	% Recovery
Phenol-d5	83	10-110	% Recovery
2-Fluorophenol	92	21-110	% Recovery
2,4,6-Tribromophenol	89	10-123	% Recovery

Samples in Batch 9307752-01 9307752-02 9307752-03 9307752-04 9307752-05

Notes
ND - Not detected.

Cynthia Schreiner, QC Officer

SPL QUALITY CONTROL REPORT
ICP ANALYSIS

DATE: 7/30/93 TIME: 09:15AM ANALYST: PQ MATRIX: P30:0 WATER
INSTRUMENT: TJA 61E FILE #: A0730 METHOD: ICP UNITS: mg/L

SAMPLE ID NUMBERS: 7665 2c 3c 7735 18A 7752 1d - 5d 7766 1c - 4c

QC SAMPLE ID: 1). 7665 2c 2).
LCSS - 2

ELEMENT PB-2	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
AL	ND	101.8	0.6201	0.4788	N/A	2.0	85.0	88.9	4
BA		105.4	0.0504	0.0482	4	2.0	92.5	90.7	2
Cu		102.6	ND	ND	N/A	0.25	92.5	91.2	1
Ni		99.4	ND			0.50	85.8	84.9	1
Be		99.0	ND			0.05	94.8	94.8	0
PB		101.2	ND			0.50	87.4	81.2	4
Cd		100.8	ND			~~0.05~~ 1.0	~~84.8~~ 123.3	101.3	2
SB		99.2	ND			0.50	84.8	86.4	2
Cr		100.8	ND			0.20	89.8	87.2	3
ZN	↓	101.4	ND	↓	↓	0.50	92.8	90.0	3
NA	↓	105.6	256.9	254.4	1	30.0	115.0	97.3	17

FLAGS: *Increased Al 2c to 0.1ppm. **~~Analytical~~ Post digested spike PQ

SUPERVISOR APPROVAL: Meaza Mariam
DATE: 8/3/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/29/93 TIME: 06:59 ANALYST: WFC MATRIX: Water - P30
INSTRUMENT: 30302 FILE #: 0729A METHOD: ~~GFAA~~ UNITS: ug/L

ELEMENT: AS

SAMPLE ID NUMBERS: 07766-1c-ffc; 07735-18A; 07501-2D; 07752-1D-5D;

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07744-1c	ND	88.8%	34.9	35.1	1	40.0	95.5%	100.2%	5
PB 7/27	ND	85.8%	———	———	———	40.0	———	———	———

FLAGS: Post-digestion spiked.

SUPERVISOR APPROVAL: Meaga Marian
DATE: ~~9/30/93~~ 7/29/93

SPL QUALITY CONTROL REPORT
ATOMIC ABSORPTION ANALYSIS

DATE: 7/29/93 TIME: 13:20 ANALYST: WFC MATRIX: Water - P302
INSTRUMENT: 3030Z FILE #: 0729B METHOD: ~~GFAA~~ UNITS: mg/L

ELEMENT: SE

SAMPLE ID NUMBERS: 07766-1c-4c; 07735-18A; 07801-2b; 07752-1D-5b.

SAMPLE ID	METHOD BLANK	LCS % REC.	ORIGINAL CONC.	DUPLICATE CONC.	RPD %	SPIKE ADDED	MS % REC.	MSD % REC.	RPD %
07794-1c	ND	98.3%	ND	ND	NA	30.0	94.3%	93.0%	1
PB 7/27	ND	94.3%				30.0			

FLAGS:

SUPERVISOR APPROVAL: Maria Davison
DATE: 7/30/93

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Broken Arrow, Oklahoma 74012 • 918-251-2858 • FAX: 918-251-2599

CLIENT: SPL ENVIRONMENTAL LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
ATTN: LAJUAN JULUN

REPORT: 14742EXb

DATE: 08-02-93

SAMPLE MATRIX: WATER
SWLO # LCS 14742
DATE EXTRACTED: 07-29-93
DATE ANALYZED: 07-29-93
METHOD REFERENCE: SW846-8330
DILUTION FACTOR: 1
SAMPLE ID: 14742 (LCS)

WATER EXPLOSIVES LAB CONTROL SPIKE RECOVERY DATA

	LCS SPIKE ADDED (ug/L)	AMT. FOUND SAMPLE (ug/L)	LCS AMT. FOUND (ug/L)	LCS PERCENT RECOVERY	QC LIMIT RECOVERY
HMX	1600	0	1432	89.5	46-151
RDX	1300	0	1314	101.1	72-129
TNB	900	0	866	96.2	74-118
TETRYL	1050	0	1213	115.5	58-120
DNB	475	0	504	106.1	79-132
TNT	750	0	749	99.9	61-145
NB	850	0	864	101.6	68-135
26DNT	1150	0	1134	98.6	77-125
24DNT	700	0	706	100.9	70-134
2NT	1450	0	1495	103.1	73-131
4NT	1000	0	1017	101.7	73-116
3NT	950	0	1047	110.2	71-127

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Broken Arrow, Oklahoma 74012 • 918-251-2858 • FAX: 918-251-2599

CLIENT: SPL ENVIRONMENTAL LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
ATTN: LAJUAN JULUN

REPORT: 14742EXc

DATE: 08-02-93

SAMPLE MATRIX: WATER
SWLO # 14742.01 MS/MSD
DATE EXTRACTED: 07-29-93
DATE ANALYZED: 07-29-93
REFERENCE: SW846-8330, EPA METHODOLOGY
DILUTION FACTOR: 1
SAMPLE ID: 9307752-01(MS/MSD)

EXPLOSIVES MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS

	SPIKE ADDED (ug/L) (dry)	AMT. FOUND (SAMPLE) SMP. (ug/L)	AMT. FOUND (MS) (ug/L)	MS PERCENT RECOVERY
HMX	1600	0	1417	88.6
RDX	1300	0	1346	103.5
1,3,5-TNB	900	0	879	97.73
TETRYL	1050	0	1094	104.1
1,3-DNB	475	0	544	114.5
2,4,6-TNT	750	0	773	103.1
NITROBENZENE	850	0	895	105.3
2,6 DNT	1150	0	1149	99.9
2,4 DNT	700	0	717	102.5
2NT	1450	0	1534	105.8
3NT	950	0	1070	112.6
4NT	1000	0	1041	104.1

	AMOUNT FOUND (MSD) (ug/L)	MSD PERCENT RECOVERY	RELATIVE PERCENT DIFFERENCE	QC LIMIT RECOVERY
HMX	1420	88.8	.2	43-145
RDX	1352	104.0	.5	65-139
1,3,5-TNB	881	97.9	.2	56-129
TETRYL	1096	104.4	.2	76-123
1,3-DNB	543	114.3	.2	76-106
2,4,6-TNT	772	102.9	.2	82-111
NITROBENZENE	895	105.3	.0	76-137
2,6 DNT	1146	99.7	.3	72-124
2,4 DNT	714	102.0	.5	80-119
2NT	1530	105.5	.3	73-130
3NT	1060	111.6	.9	72-126
4NT	1060	103.7	4	78-117

CHAIN OF CUSTODY

AND

SAMPLE RECEIPT CHECKLIST

BEST COPY

for the following Pages

2

SPL ENVIRONMENTAL LABORATORY, INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02011.01	Vire Group Inc / Colfax R&D	Colfax LA

Field Sample No / Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	ANALYSIS REQUESTED METHOD	LABORATORY REMARKS
P1-W1	7-19-93 1504	X		1L	Water	ICE	HPLC		
P1-W1	"	X		40ml	Water	HCl ICE	Volatiles		
P1-W1	"	X		1L	Water	ICE	Semi Volatiles		
P1-W1	"	X		1L	Water	HNO3 ICE	Metals		
P2-W1	7-14-93 1614	X		1L	Water	ICE	HPLC		
P2-W1	"	X		40ml	Water	HCl ICE	Volatiles		
P2-W1	"	X		1L	Water	ICE	Semi Volatiles		
P2-W1	"	X		1L	Water	HNO3 ICE	Metals		
MW1-W1	7-14-93 1758	X		1L	Water	ICE	HPLC		
MW1-W1	"	X		40ml	Water	HCl ICE	Volatiles		

Samplers (Signature)	Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Intact
Trip Blank 6 lits	DI water Hol	Date: 7/22/93 Time 0550	[signature]	Date 7/22/93 Time 0550	Intact
Alan Piechocki	Alan Piechocki	Date: 7/22/93 Time 11:18 Am	[signature]	Date: 7/22/93 Time 11:18 Am	Intact yes
Affiliation	Relinquished by (Signature) Alice Delong	Date: Time:	Received by (Signature) [signature]	Date: 7/22/93 Time 1335	Intact
Vire Group Inc	Relinquished by (Signature) 116 5029 336				

REPORT TO:
Alan L Piechocki
Vire Group Inc
224 Antibes W
Mandeville, LA 70445-4764

[signature] (SPL Hol) 7/23/93 09:00 4°C

SPL ENVIRONMENTAL LABORA[illegible] INC.
NEW ORLEANS LABORATORY
1000 Riverbend Blvd. • Suite F
St. Rose, LA 70087
(504) 467-5503

Analysis Request and Chain of Custody Record

Project No.	Company/Project Name	Project Location
07-02011.01	Vico Group, Inc / Colfax R+D	Colfax, LA

Field Sample No / Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	ANALYSIS REQUESTED TEST	ANALYSIS REQUESTED METHOD	LABORATORY REMARKS
MW1-W1	7.14.93 1758	X		1L	Water	ICE	Semi Volatiles		
MW1-W1	"	X		1L	Water	HNO3 ICE	Metals		
MW2-W1	7.20.93 0918	X		1L	Water	ICE	HPLC		Note for MW2 /
MW2-W1	"	X		40ml	Water	HCl ICE	Volatiles		Samples Labeled
MW2-W1	"	X		1L	Water	ICE	Semi Volatiles		P2
MW2-W1	"	X		1L	Water	HNO3 ICE	Metals		
P3-W1	7.21.93 0745	X		1L	Water	ICE	HPLC		
P3-W1	"	X		40ml	Water	HCl ICE	Volatiles		
P3-W1	"	X		1L	Water	ICE	Semi Volatiles		
P3-W1	"	X		1L	Water	HNO3 ICE	Metals		

Samplers (Signature)	Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Intact
[signature]	[signature]	Date 7/22/93 Time 530	[signature]	Date 7.22.93 Time 0930	Yes
	Relinquished by (Signature) [signature]	Date 7.22.93 Time 11:18 Am	Received by (Signature) [signature]	Date 7-22-93 Time 11:18 Am	Intact Yes
Affiliation: Vico Group	Relinquished by (Signature)	Date: Time:	Received by (Signature) [signature]	Date: 7/22/93 Time 1335	Intact —

REPORT TO:

Same as page 1

[signature] (SPL-Hou) 7/23/93 09:01 4C

SPL HOUSTON ENVIRONMENTAL LABORATORY

SAMPLE LOGIN CHECKLIST

DATE: 7/23/93 TIME: 09:00 CLIENT NO. _____
LOT NO. _____ CONTRACT NO. _____

CLIENT SAMPLE NOS. _____

SPL SAMPLE NOS.: _____

	YES	NO
1. Is a Chain-of-Custody form present?	✓	
2. Is the COC properly completed?	✓	
If no, describe what is incomplete:		
If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
3. Is airbill/packing list/bill of lading with shipment?	✓	
If yes, ID#: Hand		
4. Is a USEPA Traffic Report present?		✓
5. Is a USEPA SAS Packing List present?		✓
6. Are custody seals present on the package?		
If yes, were they intact upon receipt?		
7. Are all samples tagged or labeled?	✓	
Do the sample tags/labels match the COC?	✓	
If no, has the client been contacted about it? (Attach subsequent documentation from client about the situation)		
8. Do all shipping documents agree?		
If no, describe what is in nonconformity:		

9. Condition/temperature of shipping container: INTACT-4°C
10. Condition/temperature of sample bottles: GOOD-4°C
11. Sample Disposal?: SPL disposal ✓ Return to client _____

NOTES (reference item number if applicable): _____

ATTEST: _____ DATE: 7/23/93
DELIVERED FOR RESOLUTION: REC'D _____ DATE: _____
RESOLVED: _____ DATE: _____

APPENDIX 2-H

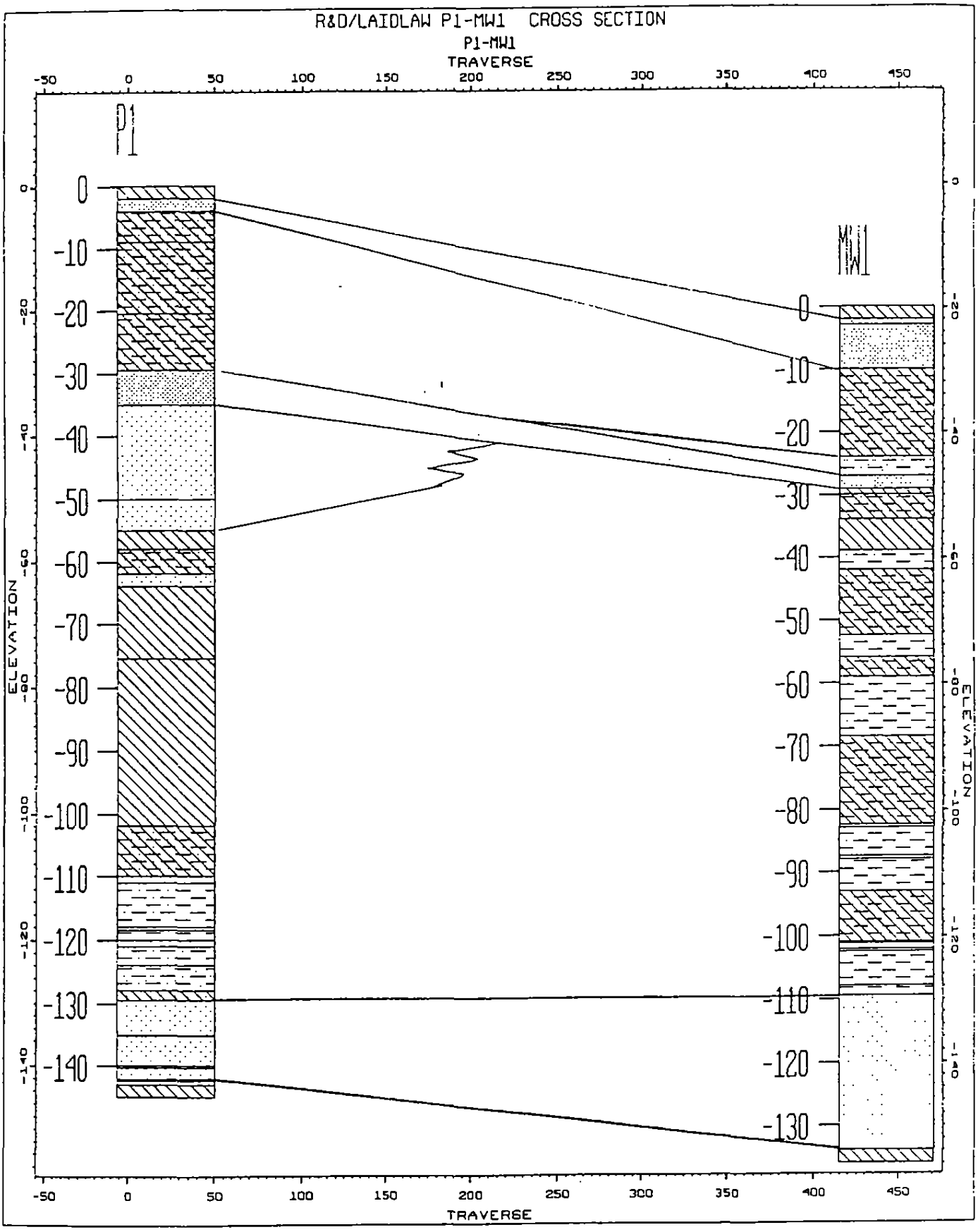
GEOLOGICAL CROSS-SECTIONS

APPENDIX 2-H

GEOLOGICAL CROSS-SECTIONS

LEGEND

0
100
TOPSOIL
SANDSTONE
CLAY
SILTY CLAY
SANDY CLAY
SILTY SANDY CLAY
SAND
SILTSTONE
NO RECOVERY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P1
MW1
ELEVATION
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50
100
150
200
250
300
350
400
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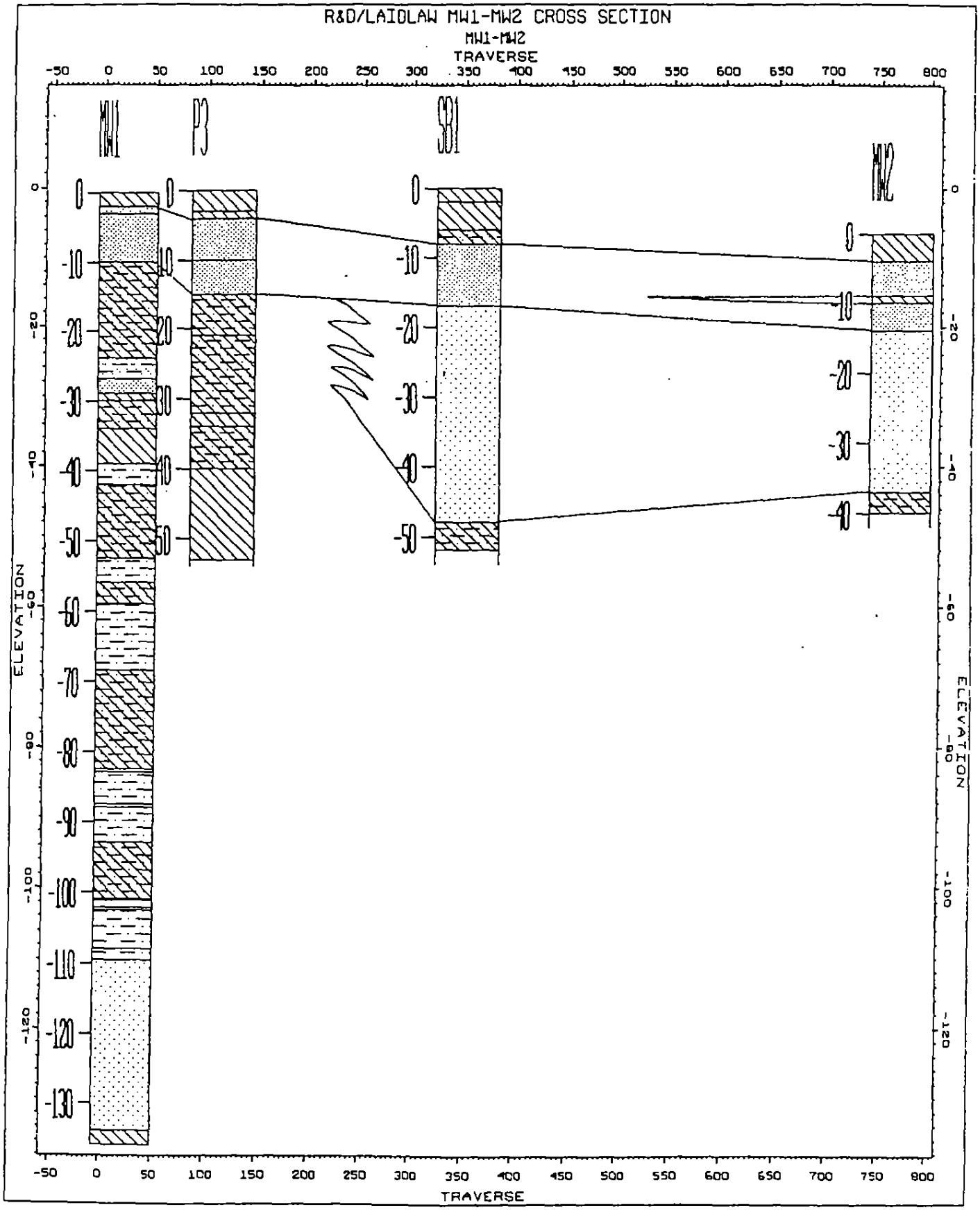
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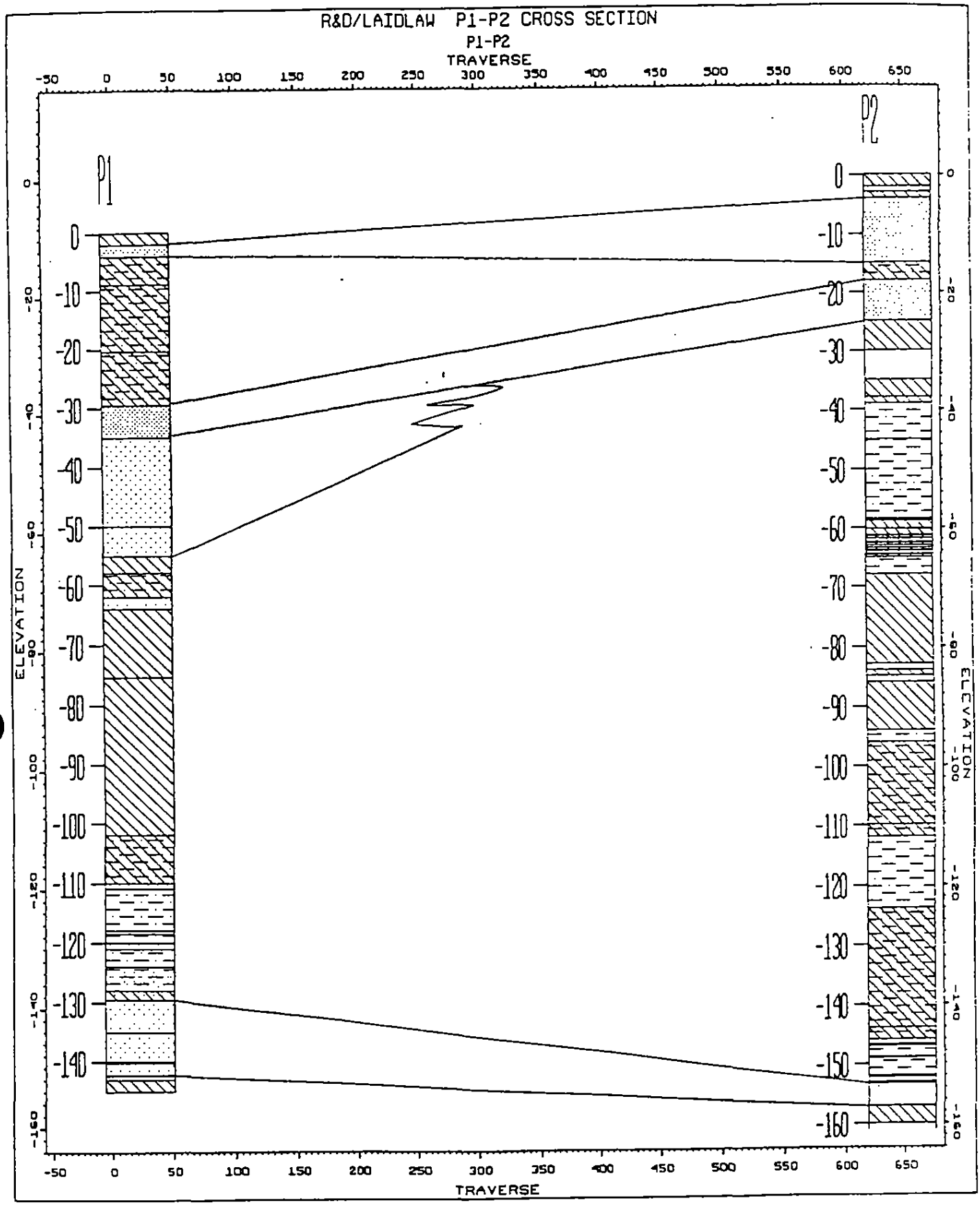
MW1-MW2
TRAVERSE
MW1
P3
S31
MW2
ELEVATION
TRAVERSE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P1
P2
ELEVATION
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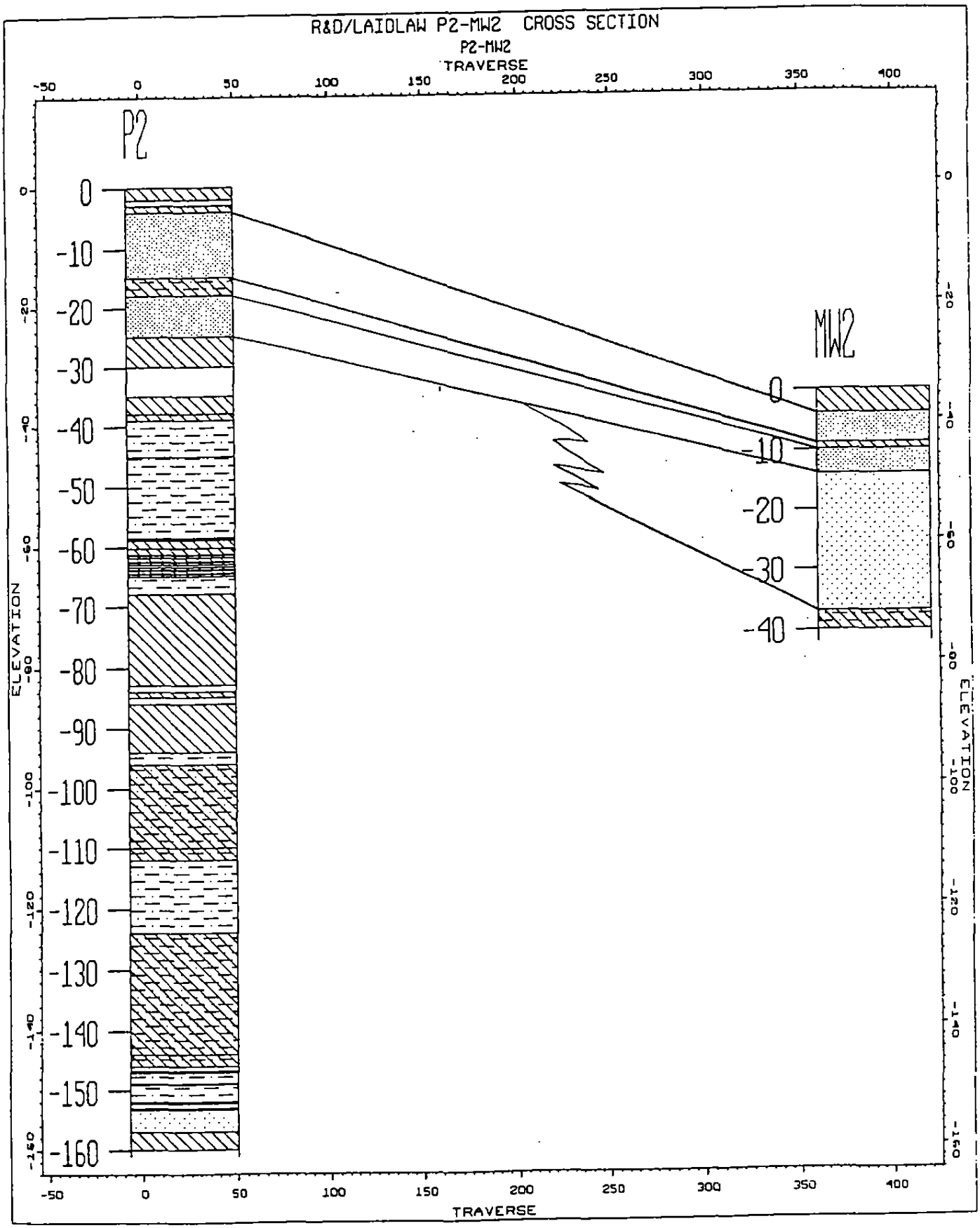
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P2
MW2
ELEVATION
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150
200
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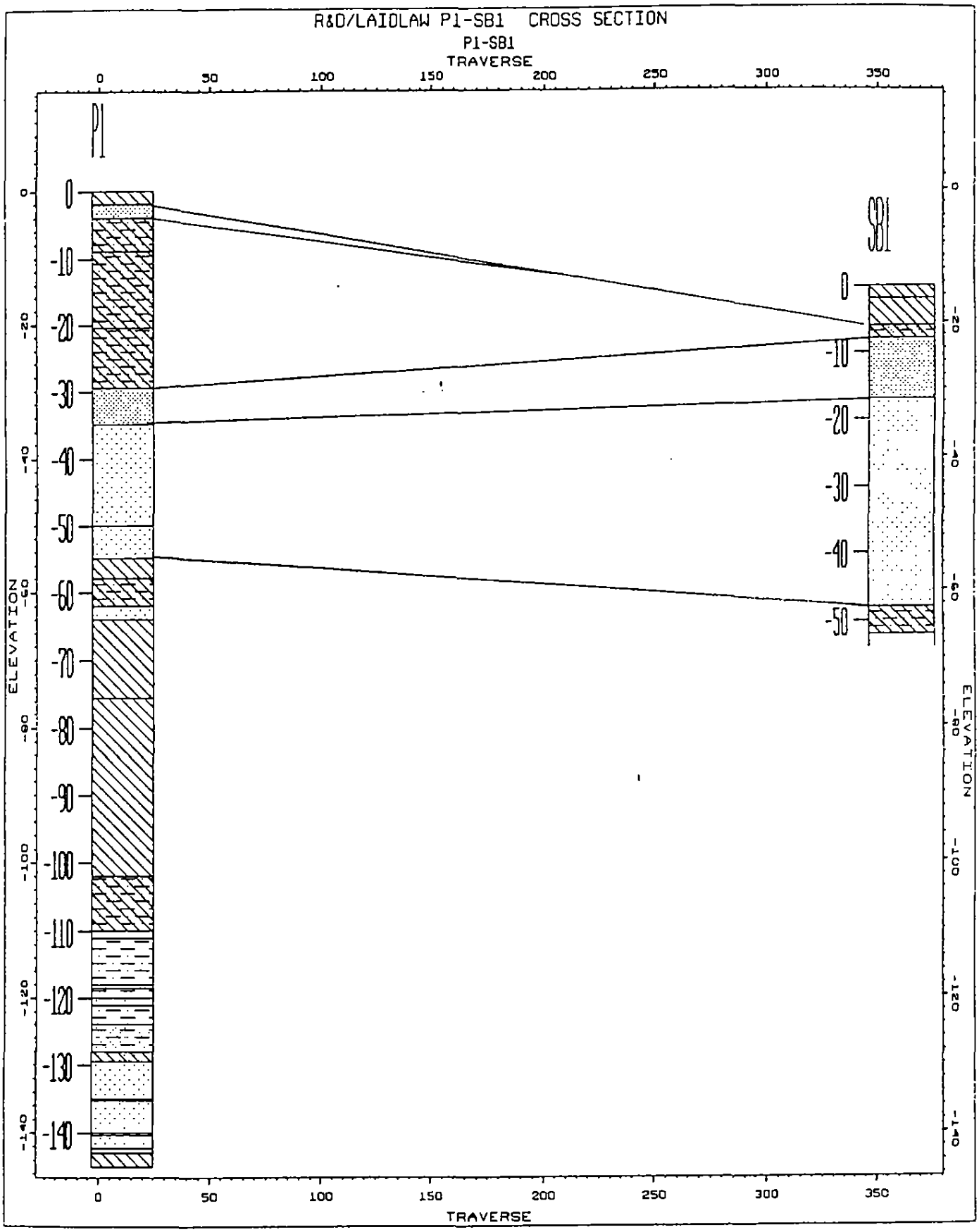
R&D/LAIOLAW P1-SB1 CROSS SECTION
P1-SB1
TRAVERSE
P1
SB1
ELEVATION
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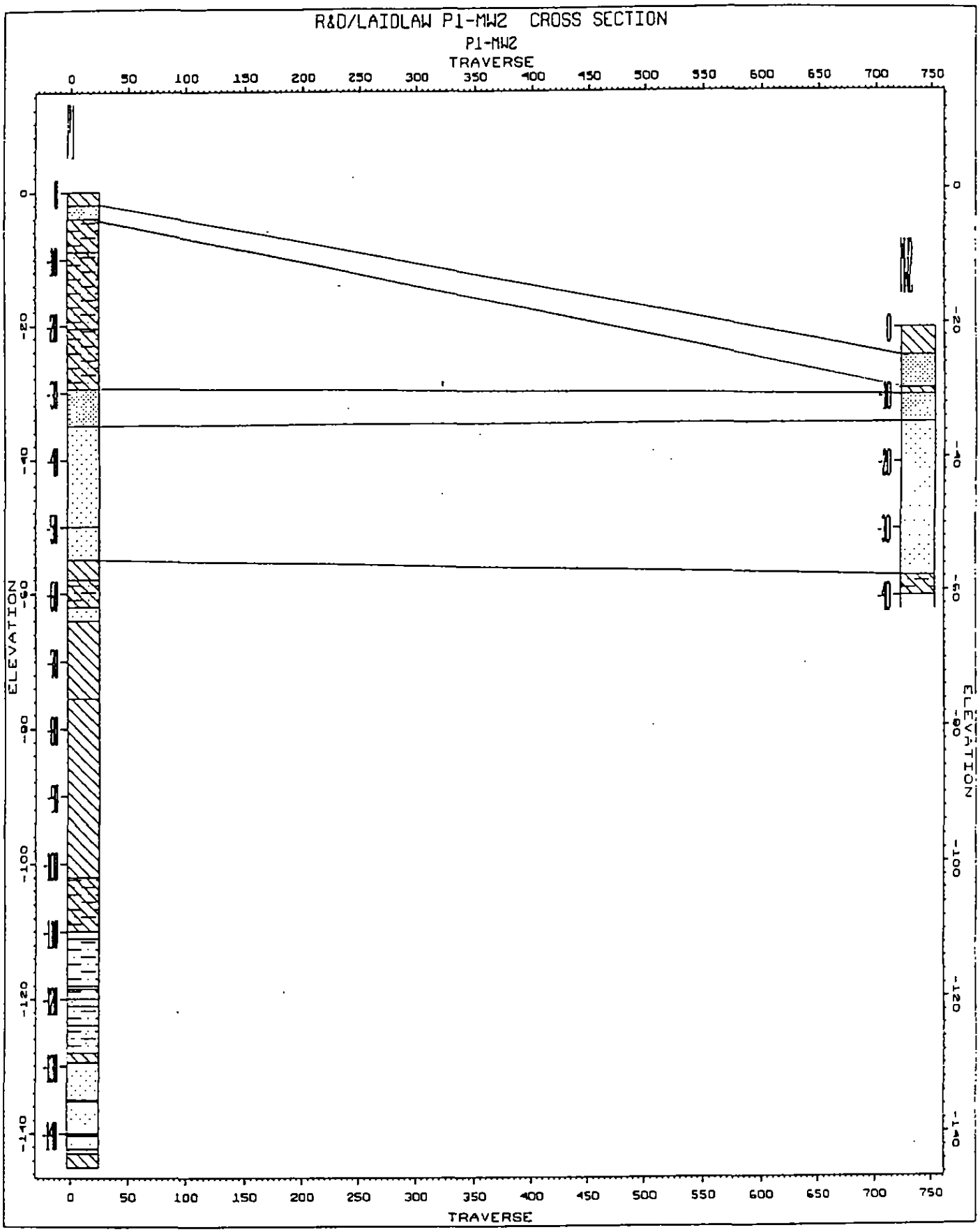
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550
600
650
700
750
ELEVATION
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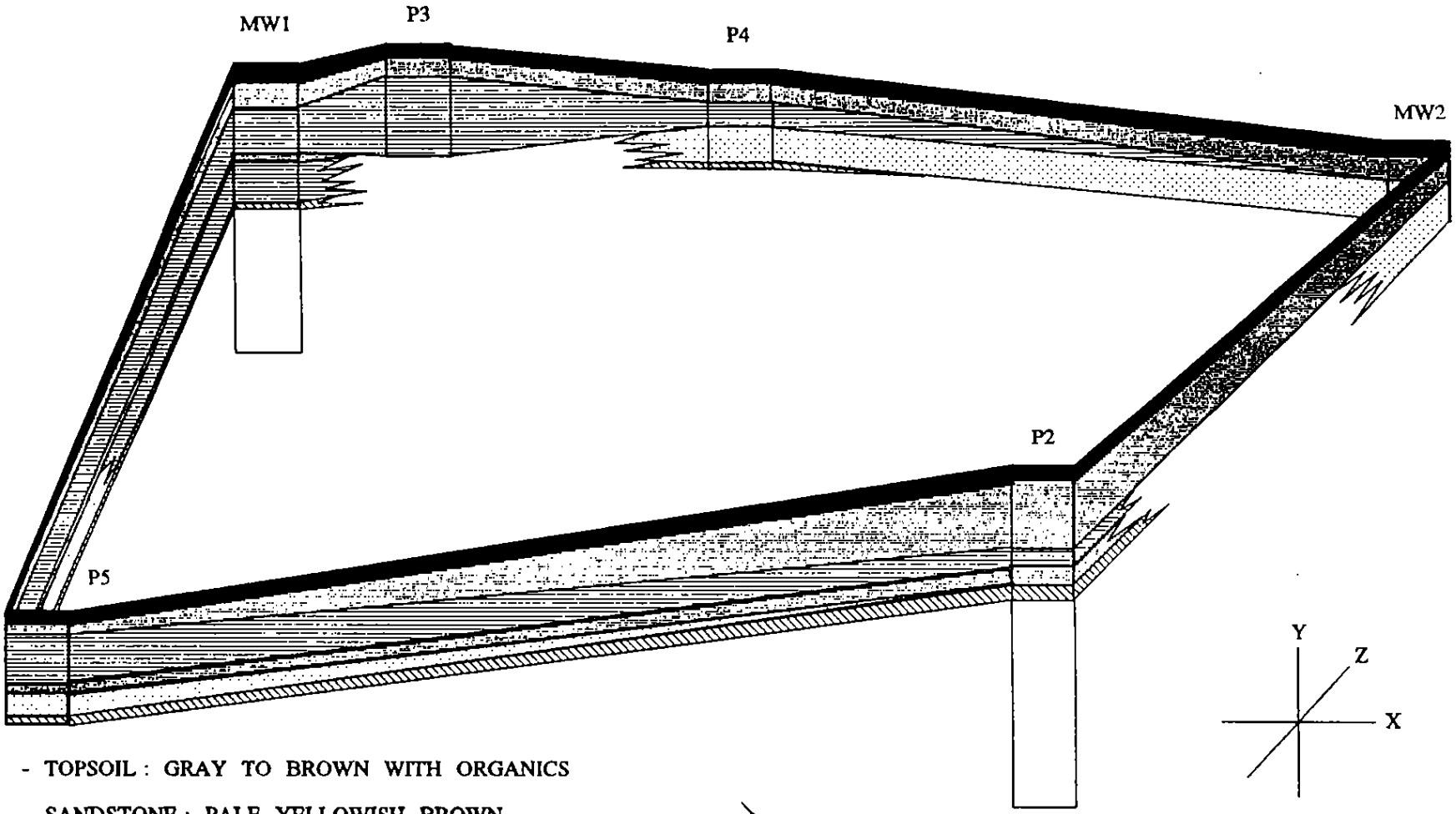
-40
-60
-80
-100
-120
-140
TRAVERSE

APPENDIX 2-I

FENCE DIAGRAM



- TOPSOIL : GRAY TO BROWN WITH ORGANICS
- SANDSTONE : PALE YELLOWISH BROWN
- SILTS AND CLAYS
- SAND : YELLOWISH GRAY
- CLAY : OLIVE GRAY

MW1 - MONITORING WELL

P3 - PIEZOMETER

N

X - 1 " = 100 '

Y - 1 " = 75 '

Z - NOT TO SCALE

ViroGroup
ETE DIVISION

GEOLOGICAL FENCE DIAGRAM

LES (Thermal Treatment), Inc.

Colfax, Louisiana

JOB NUMBER	16 - 30912
FILE	a : tt_fenc.dla
DRAWN BY	SED
DATE	1 - 94

APPENDIX 2-J

VERTICAL/HORIZONTAL SPREAD MODEL DESCRIPTION

Alternative Boundaries in Solid Waste Management

by P. A. Domenico and V. V. Palciauskas[2]

ABSTRACT

Recent trends in solid waste management seem to favor the establishment of minimum performance criteria for waste facilities, as opposed to case by case detailed operational requirements. This implies some generally acceptable upper limit of contamination, say as provided by the primary and secondary Maximum Concentration Level (MCL's) developed by the Environmental Protection Agency. Not so easily defined is the compliance point at which the MCL's may be applied, which can range from the solid waste boundary (a containment option) to some alternative boundary outside the actual waste facility (a retardation option). In either case, it follows that any contaminant migration into the public domain beyond the acceptable boundary must enter below the MCL. The containment option would appear to be strictly a matter of engineering design of the waste facility. With the retardation option, however, there is need for a simplified procedure for assessment of the hydrogeologic environment responsible for retardation and attenuation of the contaminant stream. These are largely dilution and reaction processes. In this paper, some mechanisms of dilution are examined, including geometrical spreading of a contaminant plume, recharge from precipitation, and mixing with surface-water bodies. This analysis focuses on average value calculations that constitute a semiquantitative measure of the dilution potential of waste sites prior to intensive investigations. For compliance and regulatory purposes, a simple model for maximum concentration predictions is developed for one-dimensional steady flow and dispersion in directions perpendicular to the flow path. This model is reasonably operational with a minimum of data in that it avoids chemical reaction and the inherent fitted parameter known as longitudinal dispersion, and employs the actual measured concentration at the solid waste boundary as a boundary condition. The model thus provides a conservative estimate of whether or not minimum performance standards will be achieved at an alternative boundary.

INTRODUCTION

The recent proliferation of environmental protection laws seems to coincide in time with a corresponding proliferation of transport models with a predictive capability for environmental impact. The literature demonstrates numerous site-specific studies, especially with regard to radionuclide transport and certain heavy metal migration (Baetsle, 1969; Cherry and others, 1973; Pinder, 1973). In spite of this available technology, there is still some doubt that the transport model is a practical answer to many potential contamination problems. There are several reasons for this, including the cost and time-consuming nature of site-specific investigations, the high level of uncertainty in the available data base, and the

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Discussion open until November 1, 1982.

questionable reliability of the models themselves, especially in the absence of a contamination history for calibration purposes. If the problem is either regulatory in nature or a first-order assessment of a potential hazard, there is yet another compelling reason to seek some alternative to the complex transport analysis. This latter statement reflects the recent trend in development of standards for waste disposal sites which favor the establishment of minimum performance criteria as opposed to detailed operational requirements (Clark and Sabel, 1980). Hence, the spatial and temporal analysis of constituents as provided by transport models would appear to be excessive in detail if one is interested only in minimum performance as might be expressed through some acceptable upper limit of concentration. Maximum concentration levels (MCL's), as proposed by the Environmental Protection Agency provide the standard example of an acceptable upper limit of contamination.

If regulatory procedures are to be based on some minimum performance standard, such as MCL's, one of the critical decisions is the boundary at which compliance must be demonstrated. Two possibilities exist: the solid waste boundary or some alternative boundary at some specified distance from the waste boundary. In accordance with currently accepted procedure, monitoring at the solid waste boundary serves the useful purpose of providing an accurate nationwide inventory of "open dumping" and "sanitary landfills." Indeed, the reliability of such an overdue inventory requires a common measuring point for all facilities, and the waste boundary uniquely satisfies this requirement. The purposes of inventory, however, differ markedly from the purposes of monitoring, which in this case is to assure that ground water is not transmitting contaminants to the public domain in excess of those quantities specified by some minimum performance standard. The forcing of inventory points of measurement to act as monitoring points for purposes of defining compliance may result in an unrealistic assessment of the threat of contamination. This is due largely to focusing the monitoring activities between the first (engineered structure) and second (hydrogeologic environment) lines of defense, the latter providing for important retardation and attenuating mechanisms that would go unaccounted for in the regulatory procedure. Hence, the solid waste boundary is a logical compliance point only where containment of the waste is a policy objective.

Given that containment is not a viable alternative, there is need for an alternative boundary approach in the regulatory-compliance schedule, provided that the alternative compliance boundary adequately protects the ground water. Such an approach need not provide for an exact prediction of concentration levels (which is the role of the complex transport analysis), but should address the question of whether or not minimum performance levels are achieved. In addition, the methodology should focus on parameters which embody the relevant mechanisms operating in a hydrogeologic environment and for which data are readily available. Yet another concern is that many evaluators will not possess strong technical backgrounds in the area of transport, so that complicated mathematics have to be avoided. This does not preclude the use of more sophisticated techniques if the need arises, or if the technical skills and data base are available.

For the alternative boundary analysis, some sort of ground-water modeling is required. Three different levels of models are available for this purpose. The first and simplest level is provided by predicted average values of contaminant levels, with some form of dilution being provided by mixing with uncontaminated water. Although the employment of average values enormously reduces the computational problems, they are of limited use in a regulatory scheme that is designed to monitor maximum concentration levels. Hence, as will be discussed shortly, average value calculations are useful mainly as a screening mechanism for evaluating the dilution potential for waste sites prior to intensive investigations.

The second level of sophistication is computationally no more complex than the first except that it is presented as a solution to a formal boundary value problem. This solution answers two critical questions that are generally raised in an environmental assessment of waste transport: (1) When will the waste arrive at a specific location, i.e., the alternative boundary? (2) How much of the maximum concentration level inventoried at the waste boundary will appear at the point of intake? Unfortunately, certain information is lost in this procedure, mainly the overall temporal and spatial variations that might be expected in a complex flow domain. To provide answers to this question requires yet a third level of sophistication, mainly a complex transport analysis. This type of analysis is beyond the scope of this study and, in general, may not be a necessary requirement in a regulatory scheme that focuses on ground-water protection requirements by way of minimum performance standards.

INPUT PARAMETERS

In the equations developed in this paper, two important physical parameters are required as input. The first, designated V_c, is the velocity of the contaminant. In the absence of chemical retardation, this is simply the velocity of the ground water, V_w. For cases where the partitioning of the contaminant can be described adequately through a distribution coefficient K_d

$$V_c = \frac{V_w}{1 + (\rho_b/n)\, K_d} \qquad (1)$$

where ρ_b/n is the ratio of the dry density to the porosity, commonly ranging between 4 and 10 g/cm³ for most geologic materials and, as mentioned above, the distribution coefficient governs the partitioning between the liquid and the solid matrix. In the laboratory, this partitioning is measured with column experiments where prepared solutions containing the contaminant are passed through geologic materials sampled at the site. Sometimes batch experiments are used, but are not as accurate. For fine-grained materials, distribution coefficients range in value between zero and 10^3 ml/g. Some constituents have a K_d of zero or near zero, the most common being chloride and tritium. That is, these constituents move with the velocity of ground water whereas most others will move slower relative to the ground water. In the absence of partitioning measurements, an upper bound for V_c is taken as the velocity of ground water [K_d equals zero, equation (1)], the latter a calculation that is well within the state of the art. Pertinent references for the retardation equation as given by equation (1) are Grisak and Jackson (1978), and Freeze and Cherry (1979, p. 405).

A second parameter required in the equations to follow is the transverse dispersion coefficient, designated D_T, which is a measure of the spreading of a contaminant plume that takes place perpendicular to the flow lines. Such dispersion arises between parallel flow elements due to diffusion and the tortuous pathways. It is emphasized that this is not the commonly used "fitted" longitudinal parameter of complex contaminant transport problems, referred to as the coefficient of hydrodynamic dispersion. At its lower limit for a slowly moving fluid, D_T can be approximated by a diffusion coefficient for a porous medium, which is commonly taken as 10^{-5} cm²/sec (Lerman, 1971, p. 32). Under virtually no conditions do we expect the transverse dispersion coefficient to be less than this so that 10^{-5} cm²/sec can be taken as a conservative lower bound (the lower D_T, the less the vertical and horizontal spreading of a plume and, consequently, the less it is diluted). For permeable rock units where ground water moves rather rapidly, this coefficient can be somewhat larger. In the interests of conservatism for a worst case scenario for minimum dilution, a value of 10^{-4} to 10^{-5} cm²/sec is adequate for poorly permeable materials (see, for example, Baetsle, 1969, p. 718). The absolute worst case is thus depicted as one having a distribution coefficient of zero and a transverse dispersion coefficient in the range of a typical porous media diffusion coefficient. It is emphasized here that in the alternative boundary analysis, we are not interested in predicting exact concentration levels (assuming for the moment that such a prediction is even possible in the absence of a contamination history for model calibration), but in determining whether minimum performance standards are achieved. Hence, the worst case or upper bound calculations are useful in that they should demonstrate whether or not an acceptable upper limit of concentration will be achieved at the alternative boundary.

AVERAGE VALUE APPROXIMATIONS FOR THE EFFECTS OF MIXING

Mixing is any process which causes one parcel of water to be mingled with or diluted with another. There are at least three dilution processes that can occur in contaminant transport in porous media: (1) geometrical spreading of the contaminant stream, assumed to be controlled by transverse dispersion processes; (2) continuous mixing of fresh water along the contaminant stream due to recharge from precipitation; and (3) discharge of the contaminant stream into some surface-water body, such as a stream. The dilution effects of these processes will be examined in this section.

Geometrical Spreading

A semiquantitative, conservative estimate of mixing due to transverse dispersion can be achieved through the following argument. Let us assume a transverse dispersion coefficient D_T, perpendicular to the flow lines. The contaminant flow pattern will thus be spread from the source as shown in Figure 1(a). If the transit time t is approximately equal to L/V_c, where L is the distance from the source and V_c is the contaminant velocity as determined by equation (1), then, through dispersion, the contaminant front will spread from width L_1 to $L_1 + 2(D_T t)^{1/2}$. Here, the diffusion length $(D_T t)^{1/2}$ is taken as an approximate measure of the spread, as will be demonstrated later in a boundary

value problem treating this phenomenon. If C_o is the measured concentration at the waste boundary and C_L is the concentration of the ground water further downgradient at any point L (the alternative boundary), then

$$\frac{C_L}{C_o} = \frac{1}{1 + 2(L/L_1)(D_T/V_c L)^{1/2}} = \frac{1}{1 + 2[(D_T t)^{1/2}/L_1]} \quad \ldots\ldots(2)$$

where L is the distance to the alternative boundary; and L_1 is the horizontal width of the contaminant stream at the waste boundary [Figure 1(a)].

A more realistic assessment may be obtained by a two-dimensional front where there is transverse dispersion in two directions perpendicular to the flow lines. Hence, the front will not only spread laterally but vertically as well [Figures 1(a) and 1(b)]. If the transverse dispersion coefficient is the same in both directions, the conservation of mass principle implies:

$$\frac{C_o}{C_L} = \left[1 + 2\frac{(D_T t)^{1/2}}{L_1}\right]\left[1 + 2\frac{(D_T t)^{1/2}}{L_2}\right] \quad (3)$$

or

$$\frac{C_o}{C_L} = \left[1 + \frac{2L}{L_1}(D_T/V_c L)^{1/2}\right]\left[1 + \frac{2L}{L_2}(D_T/V_c L)^{1/2}\right] \quad (4)$$

where the dimensions of the contaminant at the source are L_1 (horizontal) and L_2 (vertical), the latter being obtained from inventory wells at the waste boundary.

As L_1 will in general be much larger than L_2, the second bracketed quantity on the right-hand side of equation (4) will generally dominate the spreading process. Hence, considering lateral spreading to be insignificant, we are left with

$$\frac{C_o}{C_L} = 1 + \frac{2L}{L_2}(D_T/V_c L)^{1/2} \quad (5)$$

The interesting question regarding vertical spreading is as follows: At what distance L' from the solid waste boundary will the maximum dilution take place due to transverse spreading in a vertical plane? This will obviously occur where the contaminant plume occupies most of the thickness of the aquifer. Bear (1979, p. 252) estimates this distance to be about 10 to 15 times the aquifer thickness. In the general case of vertical spreading [Figure 1(b)], we expect the spreading thickness to be approximated by $L_2 + (D_T L/V_c)^{1/2}$ where L_2 corresponds to the thickness of the plume at the waste boundary, and L is any given distance from the boundary. As in all previous cases, the diffusion length $(D_T L/V_c)^{1/2}$ is taken as an approximate measure for the spread. For the condition that L corresponds to the distance from the waste facility where the contaminant plume occupies most of the aquifer thickness [L', Figure 1(c)], the available spreading thickness equals the aquifer thickness H so that

$$H = L_2 + (D_T L'/V_c)^{1/2} \quad (6)$$

This gives

$$L' = \frac{V_c}{D_T}(H - L_2)^2 \quad (7)$$

The distance L' can be regarded as a "mixing length" wherein the contaminant plume obtains maximum dilution due to vertical spreading. From the conservation of mass statement

$$C_{L'} = \frac{C_o L_1}{H} \quad (8)$$

where $C_{L'}$ is the concentration at L'.

Consider the following example. For V_c/D_T equals one (meter)$^{-1}$, L_2 equals 2 meters, and an aquifer thickness H of about 10 meters, L' is calculated to be about 64 meters, and $C_{L'}$ equals 0.2 C_o. Hence, the limit to vertical spreading in this case occurs about 64 meters from the waste facility. Transverse spreading throughout this distance will result in a lowering of the concentration to about 20 percent of the value observed at the waste boundary. An increase in velocity relative to transverse dispersion increases the distance L' but has no effect on the dilution potential as expressed by equation (8). An increase in aquifer thickness H,

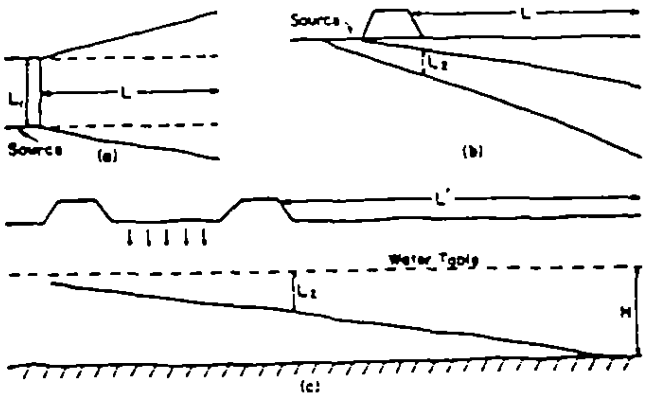

Fig. 1. Geometrical spreading of contaminant plume in a (a) horizontal plane, (b) vertical plane, and (c) vertical plane where the contaminant occupies the full aquifer thickness.

however, greatly affects L' and the concentration $C_{L'}$, occurring there.

It is clear from these developments that the variable aquifer thickness H is the most significant parameter affecting dilution potential. It is noted further that as the thickness of the plume at the waste boundary (L_1) approaches the aquifer thickness (H), the distance L' approaches zero and $C_{L'}$ approaches C_o.

Mixing with Continuous Recharge

From Figure 2, the shaded area is assumed to be contaminated ground water moving with a velocity V_c [equation (1)], and is continuously replenished by a recharge rate R (a volume of water per unit area per unit time). Let m be the amount of mass of the pollutant in the shaded region which has a volume V of $z\ell^2 n$, where z is an average plume thickness, ℓ is a unit distance, and n has already been defined as the porosity. The change in concentration with time is then

$$\frac{dC}{dt} = \frac{d(m/V)}{dt} = \frac{-m}{V^2}\frac{dV}{dt} + \frac{1}{V}\frac{dm}{dt} = \frac{-m}{V^2}\frac{dV}{dt} = \frac{-C^2}{m}\frac{dV}{dt} \quad \ldots\ldots (9)$$

where $dm/dt = 0$ since dispersion and kinetic effects are assumed to be absent. The increase in fluid volume dV/dt is just the recharge volume per unit time. Hence, $dV/dt = R\ell^2 n$ if mixing of fresh water with the pollutant is 100% effective. Substituting into equation (9) for dV/dt gives

$$\frac{dC}{dt} = \frac{-C^2}{m} R\ell^2 n \qquad (10)$$

Integrating from zero to time t yields

$$C(t) = C_o \frac{1}{1 + (R/z)\,t} \qquad (11)$$

where C_o is an initial concentration; z is an average plume thickness; and R is the recharge rate that effectively mixes with the plume over the thickness z.

Equation (11) is best applied to that part of a plume that occupies most of the thickness of an aquifer. For this case, C_o is the concentration where the plume first assumes such a thickness, z = H is the aquifer thickness, and R is the recharge rate. As an example, assume a conservative dilution rate of 1%, i.e., R/z equals 0.01 yr^{-1}. This means that C(t) equals $C_o(1 + 0.01t)$ where C_o is the concentration where the plume first assumes the full thickness of the aquifer. If the transport time

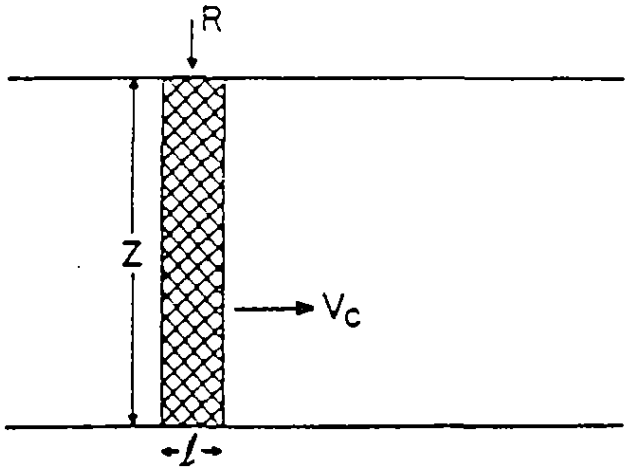

Fig. 2. Plume mixing with continuous recharge.

to some distance L is in the range of 10 years, 100 years, 1000 years, then $C_L/C_o = 0.91, 0.5$, and 0.09, respectively. Clearly, those contaminants with long travel times (low flow velocities or large distribution coefficients) undergo significant dilution.

When applied to some alternative boundary, equation (11) is better expressed

$$C_L = C_o \frac{1}{1 + (R/z)(L/V_c)} \qquad (12)$$

where C_o is the concentration as measured at the waste boundary; and L is the distance to the alternative boundary where the concentration is expected to be C_L. If the plume does not extend over the full thickness of the aquifer within this region, z is taken as an average plume thickness and R is modified to include only that part of the recharge rate that effectively mixes with the plume. This latter value can only be a very rough estimate under the best of conditions.

Mixing with Streams

Most ground water, by nature of its movement from topographically high areas to topographically low areas will eventually discharge into streams or rivers. To compute a dilution factor for discharge of contaminated water into a flowing stream, as depicted by Figure 3, one must determine the total contaminant added during some time period r, and the total volume of water in the stream that accepted this discharge during this time period. Let J be the flux (average discharge per unit time per unit area) of the contaminant at the stream boundary. The flux J equals $C_L V_c$, where C_L and V_c are the concentration of the contaminant and its velocity at the stream aquifer boundary.

respectively. The total mass of contaminant added during time period r is

$$\text{Mass added} = JYhr = C_L V_c Yhr \qquad (13)$$

where Y is the length of the discharge zone; and h is the average water depth (Figure 3).

The volume of water in the stream that flowed past the discharge zone over this time period r is

$$\text{Volume of water in stream} = VWhr \qquad (14)$$

where V is the velocity of the stream, and W is the stream width. Since the volume of fluid added to the stream is $V_c Yhr$, the concentration in the stream will be

$$C_{stream} = \frac{\text{mass added}}{\text{total volume}} = \frac{C_L V_c Yhr}{V_c Yhr + VWhr} \qquad (15)$$

or, after some rearranging

$$C_{stream} = \frac{C_L}{1 + (V/V_c)(W/Y)} \qquad (16)$$

The important factor here is the group of terms $VW/V_c Y$, which will be a very large number because V/V_c is large, where V is the stream velocity and V_c is the contaminant velocity in the ground-water flow at the stream aquifer boundary.

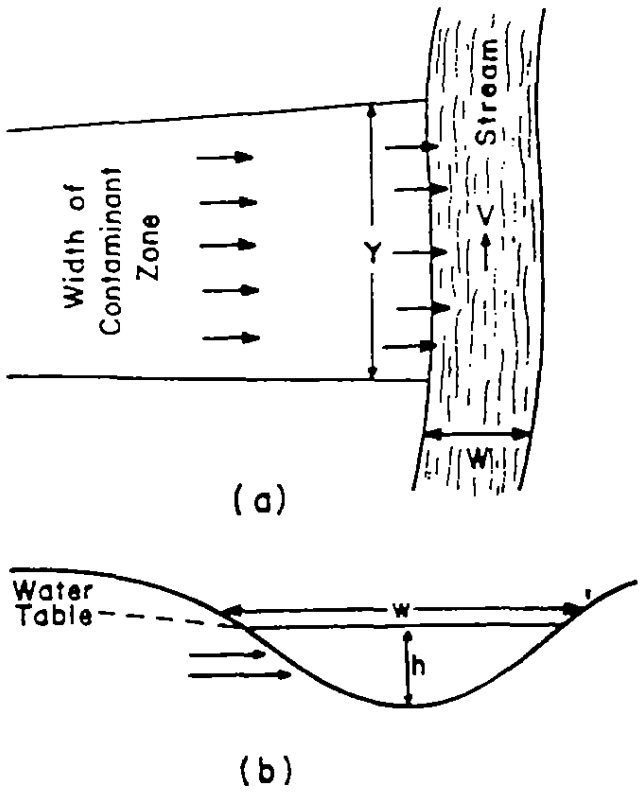

Fig. 3. Contaminant discharge into streams.

Dilution Factors

The average value approximations given in this section are designed to give the estimated concentration at some downstream point as a function of some original concentration C_o which is presumably measured with inventory wells at the solid waste boundary. Perhaps a better way to interpret these results is through dilution factors. Dilution is generally defined as the ratio of the total volume of a sample to the volume of effluent contained in a sample, and can range from one (undiluted state) to infinity (total dilution). Considering the upstream measuring point to substitute for the numerator of this ratio, and the downstream point as the denominator, the working equations can be interpreted in terms of dilution factors. Hence, for horizontal spreading [equation (2)], vertical spreading [equation (5)], and mixing with recharge [equation (12)], the ratio C_o/C_L provides a dilution factor. For mixing with streams [equation (16)], the dilution factor is C_L/C_{stream} Although it is not possible to rank these dilution factors in a consistent fashion, it is reasonable to expect that mixing with streams is the most important, and recharge by precipitation is possibly more significant than spreading, at least in humid regions of shallow ground-water contamination.

The reciprocal of the dilution factor is equal to the volume fraction of effluent and is referred to as a relative concentration. The relative concentration can range from one (undiluted state) to zero (total dilution), and of course is also easily calculated and interpreted.

A MODEL FOR VERTICAL AND HORIZONTAL SPREADING

The shortcomings of the average value approach discussed previously may far outweigh the simplicity of the calculations. At best, these calculations provide a semiquantitative measure of the dilution potential for waste sites prior to intensive investigations.

In this section we hope to enlarge on the scope of the study to provide a more realistic model that may be useful in a regulatory-compliance schedule. Once more, the aim is to focus on some alternative boundary at which minimum performance standards must be maintained. Hence, a sizeable degree of conservatism can be incorporated. In addition, this more realistic model focuses on maximum concentration levels which are of greater concern than averages in potential contamination studies.

The model is formulated as a boundary value problem that approximates the spreading of a contaminant plume in the vertical and horizontal directions perpendicular to the prevailing flow path. In essence, we have a continuous source contaminated parcel moving at a steady one-dimensional velocity subject to transverse spreading processes. Mathematically, this may be described by the dispersion-convection equation

$$D_T \left(\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial z^2} \right) - V_y \frac{\partial C}{\partial y} = 0 \qquad (17)$$

where $C(x,z,y)$ is the concentration of the contaminant as a function of position; D_T is the transverse dispersion coefficient; y represents a spatial coordinate colinear with the velocity of the contaminant V_y; and x and z represent the horizontal and vertical spatial coordinates perpendicular to the flow. The problem is thus viewed as a two-dimensional semi-infinite medium bounded at the top, $z = 0$ by a zero flux boundary, $\partial C/\partial z = 0$ at $z = 0$. Physically, this represents $z = 0$ as the top of the saturated zone in the aquifer. The boundary condition ($y = 0$) is determined through measurements at the proposed waste boundary as described previously. For simplicity we conservatively assign the maximum concentration of the contaminant, C_o, over a specified region of the plume as measured at the solid waste boundary. Thus at $y = 0$

$$C(x,z,y=0) = \begin{cases} C_o & \text{for } \begin{cases} 0 < z < Z \\ -X/2 < x < X/2 \end{cases} \text{ (shaded region in Figure 4)} \\ 0 & \text{otherwise} \end{cases}$$

The solution to equation (17) for boundary conditions above is

$$C(x,z,y) = \frac{C_o}{4} \left\{ \operatorname{erf}\left[\frac{z+Z}{2(D_T y/V_y)^{1/2}} \right] - \operatorname{erf}\left[\frac{z-Z}{2(D_T y/V_y)^{1/2}} \right] \right\} \left\{ \operatorname{erf}\left[\frac{x+X/2}{2(D_T y/V_y)^{1/2}} \right] - \operatorname{erf}\left[\frac{x-X/2}{2(D_T y/V_y)^{1/2}} \right] \right\} \qquad \ldots . \ (18)$$

This is a two-dimensional version of a well known solution presented by Morgenau and Murphy (1956, p. 238). The maximum concentration occurs at the point $x = 0$, $z = 0$. The concentration at this point from equation (18) is

$$C_y = C(x=0, z=0, y) = C_o \operatorname{erf}\left[\frac{Z}{2(D_T y/V_y)^{1/2}} \right] \operatorname{erf}\left[\frac{X}{4(D_T y/V_y)^{1/2}} \right] \qquad (19)$$

where $\operatorname{erf}(-W) = -\operatorname{erf}(W)$ has been utilized.

In this model, V_y corresponds to V_c of equation (1); C_o is the initial maximum concentration as measured in the vicinity of the solid waste boundary; Z is the vertical extent of the measurement zone where the maximum concentration has been determined in the vicinity of the solid waste boundary; X is the lateral extent of the plume at the solid waste boundary, simply taken as the length of the solid waste facility contributing contaminants to the ground-water flow (see Figure 4); y is the distance from the solid waste boundary measurement to the alternate boundary; and erf is an error function, which is well tabulated and is presented in Figure 5. The first part of the right-hand side of equation (19) (the part involving Z) is for vertical spreading whereas the second part (the part involving X) is for horizontal spreading.

Consider the following example. Measurements at a site indicate that maximum concentrations extend over a zone that is about 3 meters (about 10 feet) thick. This is Z. The waste boundary contributing to the contaminant flow (X) is about 30 m long (about 100 feet). The parameter ratio D_T/V_c is about one meter (3 feet) and an alternate boundary is taken as 150 m (about 500 feet). Equation (19) becomes

$$C_y = C_o \operatorname{erf}\left[\frac{3}{2(1 \times 150)^{1/2}} \right] \operatorname{erf}\left[\frac{30}{4(1 \times 150)^{1/2}} \right]$$

or

$$C_y = C_o \operatorname{erf}(0.12) \times \operatorname{erf}(0.62)$$

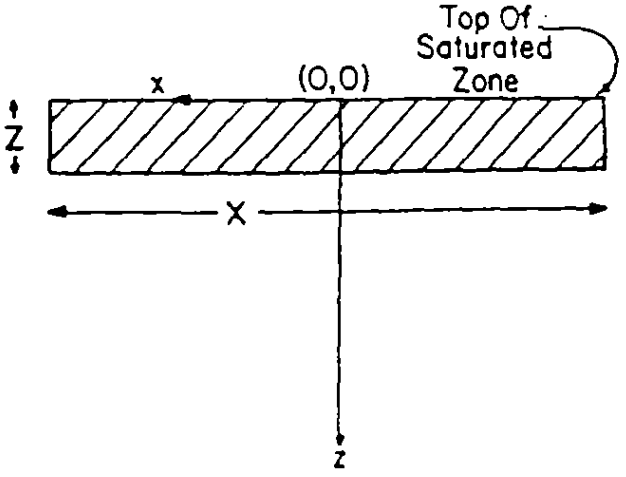

Fig. 4. Contaminant conditions at waste boundary.

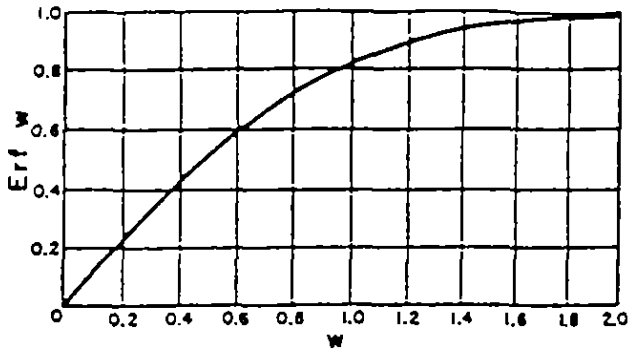

Fig. 5. Error function.

From Figure 5, erf 0.12 equals 0.13 and erf 0.62 equals about 0.61. Hence, in this case the error function of the argument is approximately equal to the argument, and

$$C_y = C_o\,(0.13)(0.61) = 0.08\,C_o$$

That is, over a distance of 150 m (about 500 feet) from the measurement at the solid waste boundary, the concentration decreases from C_o to 0.08 C_o. The quantity 1/0.08 gives the dilution factor, which in this case is about 12. Stated another way, as long as the concentration at the waste boundary is less than the MCL times 12, the concentration at the alternate boundary will be less than the MCL.

Some additional examples are given in Table 1. We have made the following assumptions:

1. No longitudinal dispersion, only transverse.

2. No chemical attenuation.

3. Recharge and other dilution mechanisms are ignored.

4. Vertical spreading is not impeded by very low permeability materials.

Of these assumptions, only No. 4 gives rise to some problems when the permeable horizon transmitting the contaminant is abnormally thin and is underlain by a continuous low permeability unit (clays or shales). For this case a better approximation would be

$$C_y = C_o \frac{Z}{H}\,\text{erf}\left[\frac{X}{4(D_T y/V_y)^{1/2}}\right] \qquad (20)$$

where all parameters are as previously defined; and H is the thickness of the available vertical spreading zone. Clearly, H would have to be very thin (perhaps two times Z) to warrant utilization of equation (20). Note that as H approaches Z, the model incorporates horizontal spreading only. The limits to horizontal and vertical spreading are factors to be determined in the field, and will of course constrain the solution given as equation (19).

CONCLUDING STATEMENTS

The average value calculations described in this paper may provide a useful screening mechanism for evaluating the dilution potential of waste sites prior to intensive investigations. Factors such as potential recharge, available spreading thickness, ground-water velocity and chemical retardation, and the proximity and nature of ground-water discharge into surface-water systems are some of the numerous factors that come into play in such an evaluation. These factors have meaning in a screening procedure only if containment of the waste is not a viable option and if minimum performance standards are regarded as acceptable in environmental protection.

The requirements of screening differ considerably from those of management control that must be employed by regulatory agencies and owners-operators of waste facilities. Clearly, the most important part of any waste management scheme is a reliable monitoring system. Given such a system, the monitoring program and the proposed

Table 1. Example Calculations for Hypothetical Situations

D_T/V_y meters	y meters	Z meters	X meters	$\frac{Z}{2(D_T y/V_y)^{1/2}}$	$\text{erf}\frac{Z}{2(D_T y/V_y)^{1/2}}$	$\frac{X}{4(D_T y/V_y)^{1/2}}$	$\text{erf}\frac{X}{4(D_T y/V_y)^{1/2}}$	$\frac{C_y}{C_o}$	$\frac{C_o}{C_y}$
1	150	3	30	0.12	0.13	0.65	0.64	0.08	12.0
1	150	6	60	0.25	0.27	1.35	0.94	0.25	3.9
1	60	3	30	0.19	0.21	1.05	0.86	0.18	5.5
1	60	6	60	0.38	0.41	2.05	0.99	0.41	2.5
2	150	3	30	0.08	0.09	0.46	0.48	0.04	23.0
2	150	6	60	0.18	0.20	0.95	0.82	0.16	6.1
2	60	3	30	0.13	0.14	0.74	0.70	0.09	10.2
2	60	6	60	0.28	0.30	1.45	0.96	0.29	3.5

regulatory and compliance procedure must be intimately related and consistent. If containment is the desired option, the problem is very simple: The compliance point is the waste boundary and any level of contamination in excess of the MCL's detected at this boundary constitutes noncompliance and either closure or upgrading. The containment option requires no evaluation of the potential contamination of a ground-water resource as no contamination is permitted.

If some part of the hydrogeologic environment outside the actual waste boundary is considered as an integral part of facility design, retardation (as opposed to containment) is the option being exercised. Presumably, the region outside the waste boundary is capable of affording some favorable combination of transport and retardation characteristics. This problem is also simple, at least in principle: the compliance point is some alternative boundary and a prescribed level of contamination detected (or predicted?) at this boundary constitutes noncompliance and either closure or upgrading. Opposed to containment, this option must be coupled with a clearly defined, simple, and consistent approach to evaluating the potential contamination of a ground-water resource. A main task is to define the alternative boundary and then clearly define what constitutes contamination beyond this boundary. Recent trends seem to rely on primary and secondary drinking-water Maximum Concentration Levels (MCL's). If MCL's represent the minimum performance of the waste facility and adjoining region, it follows that any contaminant migration into the public domain beyond the alternative boundary must enter below the MCL. The placement of the alternative boundary is a field problem, and will depend not only on hydrologic conditions, but on demographic, sociologic, and legal considerations as well.

For those situations where the geology is not overly complex, the model study presented earlier may provide some assessment on whether or not minimum performance standards can be achieved. The model is simple in that it does not require modeling a waste source term and relies on a boundary condition that is actually measured at the waste boundary. The model is conservative in that transverse spreading is the only attenuation mechanism employed, longitudinal dispersion and reactions in particular being omitted from consideration. The model need not be exact in its prediction in that the only concern is whether or not the stated minimum performance standard at the alternative boundary will be satisfied. Indeed, the model may be criticized as being too simplistic in conception and application, resulting in the prediction of unduly conservative dilution factors. However, more sophisticated modeling techniques are not precluded for complex flow systems or where the data base and/or environmental risk warrants.

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• • • • •

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PROGRAM DESCRIPTION

EPA-VHS is a simple model to predict maximum concentration at a prescribed distance downstream from a continuous pollution source (compliance point). The model is based on an analytical solution for the transport of a conservative constituent in a homogeneous, isotropic aquifer with one-dimensional, horizontal, steady-state flow and dispersion only in directions perpendicular to the flow path. The model can be used as a semi-quantitative measure for screening the dilution potential of a waste site prior to more extensive investigation. The model assumes zero retardation, a continuous input at maximum extraction levels, and saturated soil conditions. This program contains two versions: (1) the modified EPA version as published in the Federal Register, 50 FR 48886, November 27, 1985; and (2) the original VHS model as published by Domenico and Palciauskas in *Ground Water*, Vol. 20, No.3, pp. 301-311, 1982.

This menu-driven program facilitates interactive data entry and editing. The program is set up to be used with either metric (meter, day) or U.S. customary units (foot, day). For instructional purposes the program contains a set of realistic default values for the input variables, some of which are values adopted or required by EPA.

MODEL VERIFICATION

The algorithms used in the program have been tested with MathCAD (c) mathematical equation solver from MathSoft, Inc., Cambridge, Massachusetts. The MathCAD data file (EPAVHS.MCD) is available on request from the IGWMC Indianapolis office A hard copy of the MathCAD solution is enclosed as Appendix 1. Appendix 2 contains reprints of the publications on which this model is based.

To test the program a series of calculations were made using the data provided in the original publication of Domenico and Palciauskas (1982), table 1, p. 310. (See Figure 1.1-1.8). In addition, the program has been checked for consistency for both systems of units used (Figure 2.1-2.4) It should be noted that in Table 1 of Domenico and Palciauskas (1982) a reversal of numbers occurred between column 9 and 10. The correct value for C_y/C_o is 10.2, while C_o/C_y should be 0.09.

SYSTEM REQUIREMENTS

Minimum hardware and software requirements:

- IBM-PC, XT, AT, or compatible microcomputer
- 256K RAM
- Color Graphic Adapter (CGA) board
- One floppy disk drive

- DOS 2.0 or higher

Optional hardware and software:
- Math coprocessor
- A hard disk
- A BASIC compiler

DISKETTE CONTENTS

The program EPA-VHS runs on IBM PC compatible microcomputers and is distributed by IGWMC on a MS-DOS formatted 5¼" or a 3½" diskette. This diskette contains the following files:

EPAVHS.EXE - Executable image compiled with Microsoft QuickBASIC v. 4.1

EPAVHS.SCR - Graphic file required for EPAVHS.EXE; formatted for use with the BASIC command BLOAD

EPAVHS.BAS - Source of program EPA-VHS version 1.0

GWDISP.COM - A required command file to facilitate browsing through EPAVHS.DOC

README.BAT - Batch file to load GWDISP COM and EPAVHS DOC

EPAVHS.DOC - The documentation file

RUNNING EPA-VHS

Before running the program, back up the provided diskette(s) by using the DISKCOPY command of MS-DOS or PC-DOS. To run the program from a floppy disk, copy the EPAVHS.EXE and the EPAVHS.SCR files to a work diskette, place the diskette in drive A or B, and enter:

> EPAVHS

For running from a hard disk, first copy pertinent files from the provided diskette to a specified subdirectory on the hard disk. Then, enter on DOS prompt:

> EPAVHS

Each time new data are entered (or existing data modified), the program uses the latest entry (see Figure 3.1 and 3.2). To go back to the default values, re-enter them or exit the program and start again (see Figure 4.1–4.4). When a particular system of units has been selected, those units are used throughout the program. To change the system of units, exit and restart the program.

DOCUMENTATION

The documentation provided with this software consists of this report, and includes a copy of the paper of Domenico and Palciauskas, published in *Ground Water;* a copy of the Federal Register, Vol. 50, No. 229, pp. 48886–48910, Final Vertical and Horizontal Spread Model (VHS); and a copy of the paper "Use of the Vertical Horizontal Spread (VHS) Model for Delisting Hazardous Waste" by K.H. Reinert, presented at the NWWA/IGWMC conference, "Solving Ground Water Problems with Models," held in Denver, Colorado, February 1987.

Additional information on the use and applicability of the VHS model is provided in the Federal Register, Vol. 51, No. 219, pp. 41082–41100, November 13, 1986, and the Federal Register, Vol. 53, No. 48, pp. 7903–7915, March 11, 1988, among others.

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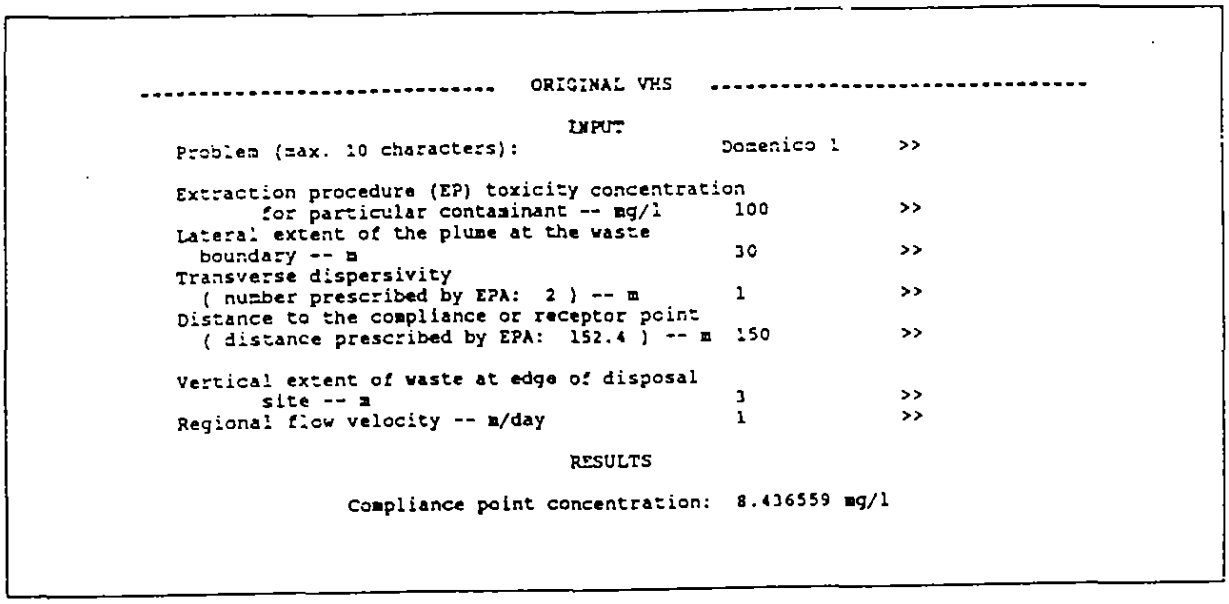
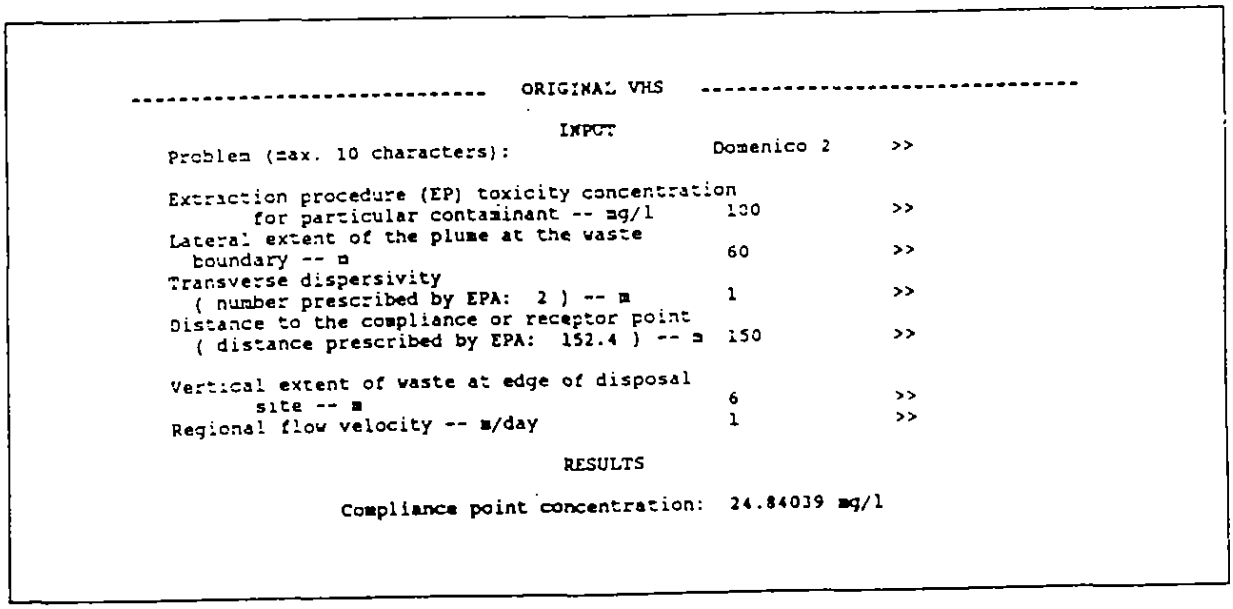


```
----------------------------- ORIGINAL VHS -------------------------------

                                  INPUT
Problem (max. 10 characters):                    Domenico 1      >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100             >>
Lateral extent of the plume at the waste
  boundary -- m                                  30              >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          1               >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    150             >>

Vertical extent of waste at edge of disposal
      site -- m                                  3               >>
Regional flow velocity -- m/day                  1               >>

                                  RESULTS

              Compliance point concentration:  8.436559 mg/l
```

Figure 1.1.



```
----------------------------- ORIGINAL VHS -------------------------------

                                  INPUT
Problem (max. 10 characters):                    Domenico 2      >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100             >>
Lateral extent of the plume at the waste
  boundary -- m                                  60              >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          1               >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    150             >>

Vertical extent of waste at edge of disposal
      site -- m                                  6               >>
Regional flow velocity -- m/day                  1               >>

                                  RESULTS

              Compliance point concentration:  24.84039 mg/l
```

Figure 1.2.

```
------------------------------  ORIGINAL VHS  ------------------------------

                                  INPUT
  Problem (max. 10 characters):                  Domenico 3      >>

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l       100             >>
  Lateral extent of the plume at the waste
    boundary -- m                                30              >>
  Transverse dispersivity
    ( number prescribed by EPA:  2 ) -- m        1               >>
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  152.4 ) -- m  60              >>

  Vertical extent of waste at edge of disposal
        site -- m                                3               >>
  Regional flow velocity -- m/day                1               >>

                                  RESULTS

                Compliance point concentration:  17.89264 mg/l
```

Figure 1.3

```
------------------------------  ORIGINAL VHS  ------------------------------

                                  INPUT
  Problem (max. 10 characters):                  Domenico 4      >>

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l       100             >>
  Lateral extent of the plume at the waste
    boundary -- m                                60              >>
  Transverse dispersivity
    ( number prescribed by EPA:  2 ) -- m        1               >>
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  152.4 ) -- m  60              >>

  Vertical extent of waste at edge of disposal
        site -- m                                6               >>
  Regional flow velocity -- m/day                1               >>

                                  RESULTS

                Compliance point concentration:  41.35505 mg/l
```

Figure 1.4.

```
----------------------------- ORIGINAL VHS -------------------------------

                                  INPUT
Problem (max. 10 characters):                    Domenico 5      >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100             >>
Lateral extent of the plume at the waste
  boundary -- m                                  30              >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          2               >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    150             >>

Vertical extent of waste at edge of disposal
      site -- m                                  3               >>
Regional flow velocity -- m/day                  1               >>

                                  RESULTS

              Compliance point concentration:  4.481093 mg/l
```

Figure 1.5

```
----------------------------- ORIGINAL VHS -------------------------------

                                  INPUT
Problem (max. 10 characters):                    Domenico 6      >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100             >>
Lateral extent of the plume at the waste
  boundary -- m                                  60              >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          2               >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    150             >>

Vertical extent of waste at edge of disposal
      site -- m                                  6               >>
Regional flow velocity -- m/day                  1               >>

                                  RESULTS

              Compliance point concentration:  15.08034 mg/l
```

Figure 1.6.

```
----------  ORIGINAL VHS  ----------

                    INPUT
Problem (max. 10 characters):              Domenico 7     >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l   100           >>
Lateral extent of the plume at the waste
  boundary -- m                            30            >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m    2             >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m  60        >>

Vertical extent of waste at edge of disposal
      site -- m                            3             >>
Regional flow velocity -- m/day            1             >>

                    RESULTS

          Compliance point concentration:  10.24296 mg/l
```

Figure 1.7.

```
----------  ORIGINAL VHS  ----------

                    INPUT
Problem (max. 10 characters):              Domenico 8     >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l   100           >>
Lateral extent of the plume at the waste
  boundary -- m                            60            >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m    2             >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m  60        >>

Vertical extent of waste at edge of disposal
      site -- m                            6             >>
Regional flow velocity -- m/day            1             >>

                    RESULTS

          Compliance point concentration:  28.55453 mg/l
```

Figure 1.8.

```
------------------------------ EPA-MODIFIED VHS ------------------------------

                              INPUT
Problem (max. 10 characters):                    Test 01        >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100            >>
Width of a single disposal trench
  ( width prescribed by EPA:  12.192 ) -- m      12.192         >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          2              >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    152.4          >>
Waste volume -- cub.m                            500            >>
Cross-sectional area of disposal site, normal
      to flow direction -- sq.m                  29.72897       >>

                              RESULTS

                    Disposal trench length:  16.81861 m
                Compliance point concentration:  4.225991 mg/l
```

Figure 2.1.

```
------------------------------  ORIGINAL VHS  ------------------------------

                              INPUT
Problem (max. 10 characters):                    Test 02        >>

Extraction procedure (EP) toxicity concentration
      for particular contaminant -- mg/l         100            >>
Lateral extent of the plume at the waste
  boundary -- m                                  16.81861       >>
Transverse dispersivity
  ( number prescribed by EPA:  2 ) -- m          2              >>
Distance to the compliance or receptor point
  ( distance prescribed by EPA:  152.4 ) -- m    152.4          >>

Vertical extent of waste at edge of disposal
      site -- m                                  4.938016       >>
Regional flow velocity -- m/day                  1              >>

                              RESULTS

                Compliance point concentration:  4.225991 mg/l
```

Figure 2.2.

```
---------------------------- EPA-MODIFIED VHS ------------------------------

                                INPUT
  Problem (max. 10 characters):                  Test 03        >>

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l       100            >>
  Width of a single disposal trench
    ( width prescribed by EPA:  40 ) -- ft       40             >>
  Transverse dispersivity
    ( number prescribed by EPA:  6.56168 ) -- ft 6.56168        >>
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  500 ) -- ft   500            >>
  Waste volume -- cub.ft                         17657.33       >>
  Cross-sectional area of disposal site, normal
        to flow direction -- sq.ft               320            >>

                                RESULTS

                    Disposal trench length:  55.17916 ft
              Compliance point concentration:  4.22599 mg/l
```

Figure 2.3

```
----------------------------  ORIGINAL VHS  ------------------------------

                                INPUT
  Problem (max. 10 characters):                  Test 04        >>

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l       100            >>
  Lateral extent of the plume at the waste
    boundary -- ft                               55.17916       >>
  Transverse dispersivity
    ( number prescribed by EPA:  6.56168 ) -- ft 6.56168        >>
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  500 ) -- ft   500            >>

  Vertical extent of waste at edge of disposal
        site -- ft                               16.20084       >>
  Regional flow velocity -- ft/day               3.28084        >>

                                RESULTS

              Compliance point concentration:  4.22599 mg/l
```

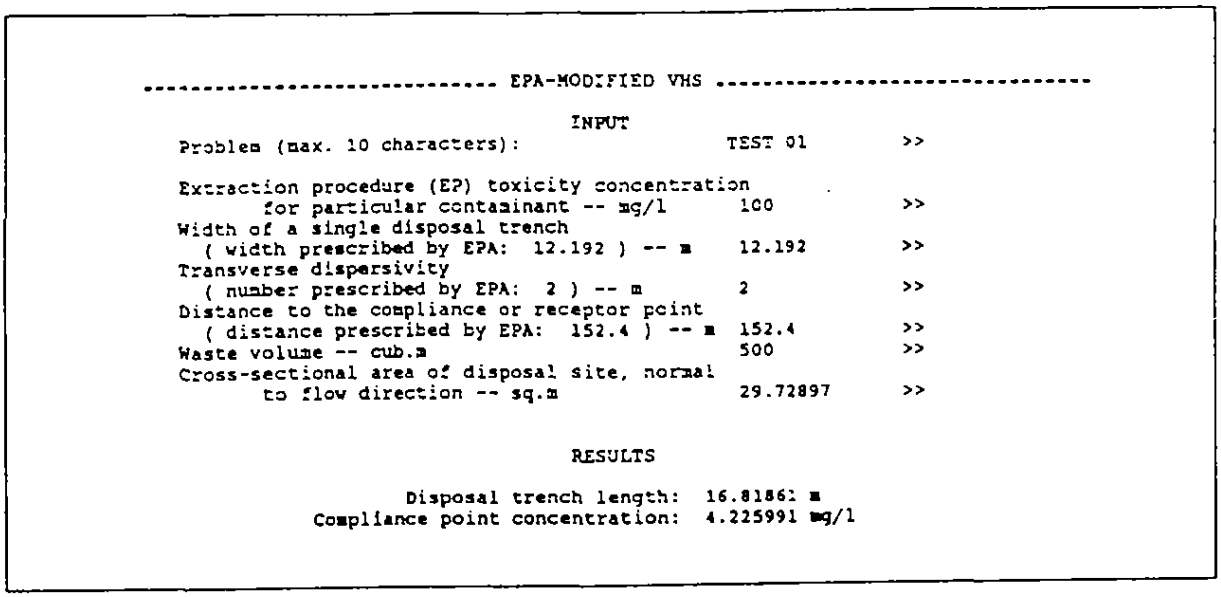
Figure 2.4.

```
------------------------------ EPA-MODIFIED VHS ------------------------------

                                  INPUT
  Problem (max. 10 characters):                    TEST 01        >> EXAMPLE

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l         100            >>
  Width of a single disposal trench
    ( width prescribed by EPA:  12.192 ) -- m      12.192         >> 10
  Transverse dispersivity
    ( number prescribed by EPA:  2 ) -- m          2              >> 1
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  152.4 ) -- m    152.4          >> 200
  Waste volume -- cub.m                            500            >> 1000
  Cross-sectional area of disposal site, normal
        to flow direction -- sq.m                  29.72897       >> 50

                                  RESULTS

                    Disposal trench length:  20 m
              Compliance point concentration:  4.810802 mg/l
```

Figure 3.1

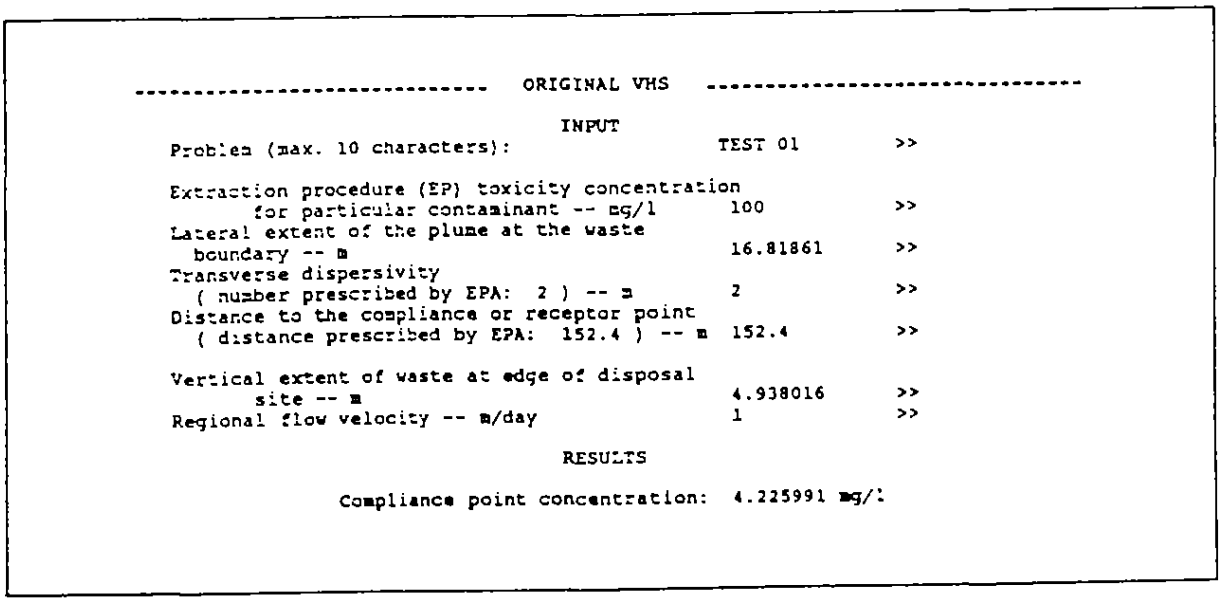
```
------------------------------ EPA-MODIFIED VHS ------------------------------

                                  INPUT
  Problem (max. 10 characters):                    EXAMPLE        >>

  Extraction procedure (EP) toxicity concentration
        for particular contaminant -- mg/l         100            >>
  Width of a single disposal trench
    ( width prescribed by EPA:  12.192 ) -- m      10             >>
  Transverse dispersivity
    ( number prescribed by EPA:  2 ) -- m          1              >>
  Distance to the compliance or receptor point
    ( distance prescribed by EPA:  152.4 ) -- m    200            >>
  Waste volume -- cub.m                            1000           >>
  Cross-sectional area of disposal site, normal
        to flow direction -- sq.m                  50             >>

                                  RESULTS

                    Disposal trench length:  20 m
              Compliance point concentration:  4.810802 mg/l
```

Figure 3.2.



```
---------------------------- EPA-MODIFIED VHS ------------------------------

                              INPUT
 Problem (max. 10 characters):                  TEST 01        >>

 Extraction procedure (EP) toxicity concentration
       for particular contaminant -- mg/l       100            >>
 Width of a single disposal trench
   ( width prescribed by EPA:  12.192 ) -- m    12.192         >>
 Transverse dispersivity
   ( number prescribed by EPA:  2 ) -- m        2              >>
 Distance to the compliance or receptor point
   ( distance prescribed by EPA:  152.4 ) -- m  152.4          >>
 Waste volume -- cub.m                          500            >>
 Cross-sectional area of disposal site, normal
       to flow direction -- sq.m                29.72897       >>

                              RESULTS

                 Disposal trench length:  16.81861 m
           Compliance point concentration:  4.225991 mg/l
```

Figure 4.1.



```
----------------------------  ORIGINAL VHS  -------------------------------

                              INPUT
 Problem (max. 10 characters):                  TEST 01        >>

 Extraction procedure (EP) toxicity concentration
       for particular contaminant -- mg/l       100            >>
 Lateral extent of the plume at the waste
   boundary -- m                                16.81861       >>
 Transverse dispersivity
   ( number prescribed by EPA:  2 ) -- m        2              >>
 Distance to the compliance or receptor point
   ( distance prescribed by EPA:  152.4 ) -- m  152.4          >>

 Vertical extent of waste at edge of disposal
       site -- m                                4.938016       >>
 Regional flow velocity -- m/day                1              >>

                              RESULTS

           Compliance point concentration:  4.225991 mg/l
```

Figure 4.2.

APPENDIX 1: MATHEMATICAL MODEL AND MATHCAD TEST DATA

THE VERTICAL AND HORIZONTAL SPREAD MODEL EPA-VHS

ASSUMPTIONS: - continuous source
- steady one-dimensional horizontal flow
- no longitudinal dispersion

VERSION 1: MODIFIED EPA/VHS - NOVEMBER 1985

INPUT DATA:

$C_0 \equiv 100$ Extraction Procedure (EP) toxicity concentration for particular contaminant

$Y' \equiv 12.2$ Width of a single disposal trench (Fixed number, defined by EPA)

$a_t \equiv 2$ $R_{tz} \equiv 10$ a_t = transverse dispersivity; a_z = vertical dispersivity; $R_{tz} = a_t/a_z$ (fixed numbers, defined by EPA)

$Y_E \equiv 152.4$ Distance to the compliance or receptor point (fixed number, defined by EPA)

$W_v \equiv 500$ Waste volume, used to calculate X_E, the disposal trench length

$AREA \equiv 29.8$ Cross-sectional area of disposal site, normal to flow direction used to calculate X_E

RESULTS: $a_z = 0.2$

Disposal trench length $X_E = 16.779$

Compliance point concentration: $C_E = 4.218$

VERSION 2: DOMENICO AND PALCIAUSKAS 1982

ADDITIONAL INPUT:

$V_y \equiv 1$ Regional flow velocity

RESULTS:

Transverse dispersion coefficient:	$D_T = 2$
Vertical extent of waste in groundwater at edge of disposal site (back-calculated from EPA-VHS):	$Z = 1.562$
Distance from solid waste boundary to compliance point (alternative boundary):	$Y_P = 152.4$
Lateral extent of the plume at the solid waste boundary:	$X_P = 16.779$
Compliance point concentration:	$C_P = 1.342$

EQUATIONS

General Definitions:

$$X_P := X_E \qquad a_z := \frac{a_t}{R_{tz}} \qquad Z := \sqrt{a_z \cdot Y'} \qquad Y_P := Y_E \qquad D_T := a_t \cdot V_y$$

Calculation Resulting Concentrations:

VERSION 1

$$C_E := C_0 \cdot \operatorname{erf}\left[\sqrt{\frac{Y'}{4 \cdot Y_E}}\right] \cdot \operatorname{erf}\left[\frac{X_E}{4 \cdot \sqrt{a_t \cdot Y_E}}\right]$$

VERSION 2

$$C_P := C_0 \cdot \operatorname{erf}\left[\frac{Z}{2 \cdot \sqrt{D_T \cdot \frac{Y_P}{V_y}}}\right] \cdot \operatorname{erf}\left[\frac{X_P}{4 \cdot \sqrt{D_T \cdot \frac{Y_P}{V_y}}}\right]$$

Additional Global Definitions:

$$X_E \equiv \frac{W_v}{AREA}$$

APPENDIX 2: BACKGROUND DOCUMENTS

Domenico, P.A., and A.A. Palciauskas. 1982. Alternative Boundaries in Solid Waste Management. *Ground Water* 20(3):301–311.

Federal Register (FR) Nov. 27, 1985. 40 CFR Part 261, Hazardous Waste Management Systems; Identification and Listing of Hazardous Waste; Final Exclusions and Final Vertical and Horizontal Spread Model (VHS). *FR* 50(229):48886–48910.

Reinert, K.H. 1987. Use of the Vertical Horizontal Spread (VHS) Model for Delisting Hazardous Waste. In *Proceedings NWWA/IGWMC Conference on Solving Groundwater Problems with Models,* Denver, Colorado, February 10–12, 1987. Nat. Water Well Assoc., Dublin, Ohio, pp. 1384–1398.